2022 Diversified Agriculture Mechanization Core

Program CIP: 01.0000—Agriculture, General

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The Research and Curriculum Unit (RCU), located in Starkville, as part of Mississippi State University (MSU), was established to foster educational enhancements and innovations. In keeping with the land-grant mission of MSU, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Acknowledgments

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Standards

Standards and alignment crosswalks are referenced in the appendix. Depending on the curriculum, these crosswalks should identify alignment to the standards mentioned below, as well as possible related academic topics as required in the Subject Area Testing Program in Algebra I, Biology I, English II, and U.S. History from 1877, which could be integrated into the content of the units. Mississippi's CTE diversified agriculture mechanization core curriculum is aligned to the following standards:

National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards
The National AFNR Career Cluster Content Standards were developed by the National Council on Agricultural Education to serve as a guide for what students should know or be able to do through a study of agriculture in Grades 9-12 and two-year postsecondary programs. The standards were extensively researched and reviewed by leaders in the agricultural industry, secondary and postsecondary instructors, and university specialists. The standards consist of a pathway content standard for each of the eight career pathways. For each content standard, performance elements representing major topic areas with accompanying performance indicators were developed. Measurements of assessment of the performance elements and performance indicators were developed at the basic, intermediate, and advanced levels. The National AFNR Career Cluster Content Standards are copyrighted to the National Council for Agricultural Education and are used by permission.
thecouncil.ffa.org/afnr

International Society for Technology in Education Standards (ISTE)
Reprinted with permission from *ISTE Standards for Students* (2016). All rights reserved. Permission does not constitute an endorsement by ISTE.
iste.org

College- and Career-Ready Standards
College- and career-readiness standards emphasize critical thinking, teamwork, and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Readiness Standards (MCCRS) to provide a consistent, clear understanding of what students are expected to learn and so teachers and parents know what they need to do to help them.
mdek12.org/oae/college-and-career-readiness-standards

Framework for 21st Century Learning
In defining 21st-century learning, the Partnership for 21st Century Skills has embraced key themes and skill areas that represent the essential knowledge for the 21st century: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; environmental literacy; learning and innovation skills; information, media, and technology skills; and life and career skills. 21 *Framework Definitions* (2019).

battelleforkids.org/networks/p21/frameworks-resources

Preface

Secondary CTE programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing applied learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments. This document provides information, tools, and solutions that will aid students, teachers, and schools in creating and implementing applied, interactive, and innovative lessons. Through best practices, alignment with national standards and certifications, community partnerships, and a hands-on, student-centered concept, educators will be able to truly engage students in meaningful and collaborative learning opportunities.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Strengthening Career and Technical Education for the 21st Century Act, 2019 [Perkins V]; and Every Student Succeeds Act, 2015).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers:

Curriculum, Assessment, Professional Learning
: Program resources can be found at the RCU's website, rcu.msstate.edu.

Learning Management System: An Online Resource
: Learning management system information can be found at the RCU's website, under Professional Learning.

Should you need additional instructions, call the RCU at 662.325.2510.

Executive Summary

Pathway Description
The diversified agriculture mechanization core curriculum is a one-Carnegie unit course within the diversified agriculture pathway All students must successfully complete the principles of agriscience prerequisite course before being allowed to enroll in the diversified agriculture mechanization core course. Emphasis in this pathway is centered on teaching advanced skills in mechanization as they apply to various aspects of an agricultural work environment. Students will attain advanced knowledge and skills in areas such as electricity, welding and fabrication, hydraulics and pneumatics, and the management and operation of agricultural equipment. Focus is on an active learning environment enriched with technology, engineering, and math-based applications.

College, Career, and Certifications
No national industry-recognized certifications are known to exist at this time in the field of agriculture mechanization. Competencies and suggested performance indicators in this course have been correlated, however, to the AFNR Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Grade Level and Class Size Recommendations
It is recommended that students enter this program as 10th graders. Exceptions to this are a district-level decision based on class size, enrollment numbers, and student maturity. A maximum of 25 students is recommended for classroom-based courses, while a maximum of 15 students is recommended for lab-based courses.

Student Prerequisites
For students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in high school-level math (last course taken or the instructor can specify the level of math instruction needed)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading and math score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Assessment
The latest assessment blueprint for the curriculum can be found at rcu.msstate.edu/curriculum/curriculumdownload.

Applied Academic Credit
The latest academic credit information can be found at mdek12.org/ese/approved-course-for-the-secondary-schools.

Teacher Licensure
The latest teacher licensure information can be found at mdek12.org/oel/apply-for-an-educator-license.

Professional Learning
If you have specific questions about the content of any of the training sessions provided, please contact the RCU at 662.325.2510.

Course Outlines

This curriculum consists of one 1-credit course.

Diversified Agriculture Mechanization Core—Course Code: 991004

Unit	Title	Hours
1	Leadership and SAE for All	5
2	Introduction to Agricultural Mechanization	10
3	Safety Applications in Agricultural Mechanization	10
4	Principles of Welding	20
5	Oxyfuel Cutting and Welding and Plasma-Cutting Operations	20
6	Hydraulic and Pneumatic Systems in Agriculture	10
7	Electrical Systems Applications in Agriculture	10
8	Principles of Engines	30
9	Management and Operation of Agricultural Equipment	25
Total		**140**

Career Pathway Outlook

Overview

The agricultural sciences career cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Agriculture, during the next five years (2020-2025) 59,400 jobs are expected to open in food, agriculture, renewable natural resources, or the environment for graduates with bachelor's or higher degrees in those areas. Almost half of those jobs will be in management and business at 42%; 31% in science, technology, engineering, and math in agriculture; 13% in sustainable food and biomaterials production; and 14% in education, communication, and government services. According to USDA, agriculture, food, and related industries contributed $1.109 trillion to the U.S. gross domestic product (GDP) in 2019. The Mississippi Department of Agriculture and Commerce reports that agriculture is Mississippi's number one industry at $7.35 billion and employing approximately 17.4% of the state's workforce.

Diversified agriculture will target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (2016). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Description	Jobs, 2016	Projected Jobs, 2026	Change (Number)	Change (Percent)	Average Yearly Earnings, 2020
Agricultural and Food Science Technicians	260	270	10	3.9%	$39,270
Agricultural Sciences Teachers, Postsecondary	150	160	10	6.7%	$93,260
Animal Trainers	100	110	10	10%	$23,120
Career/Technical Education Teachers, Middle School	320	350	30	9.4%	$47,270
Career/Technical Education Teachers, Secondary School	1220	1310	90	7.4%	$50,370
Conservation Scientists	700	730	30	4.3%	$54,950
Environmental Engineers	410	420	10	2.4%	$75,940
Environmental Engineering Technicians	160	170	10	6.3%	$46,790
Environmental Scientists and Specialists, Including Health	620	670	50	8.1%	$64,460

Environmental Science and Protection Technicians, Including Health	420	460	40	9.5%	$38,780
Farm and Home Management Advisors	290	300	10	3.2%	$38,650
Logging Equipment Operators	1,680	1,740	60	3.6%	$41,840
Landscaping and Groundskeeping Workers	6,000	6,620	620	10.3%	$25,630
Nonfarm Animal Caretakers	1,520	1,780	260	17.1%	$24,030
Soil and Plant Scientists	110	110	0	0%	$92,250
Farmers, Ranchers, and Other Agricultural Managers	1,790	1,840	20	2.8%	$55,830
First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	980	1,090	110	11.2%	$40,270
First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	940	990	50	5.3%	$54,550
Fish and Game Wardens	40	40	0	0%	$46,610
Foresters	190	200	10	5.3%	$52,660
Surveyors	450	470	20	4.4%	$48,600
Surveying and Mapping Technicians	530	550	20	3.8%	$39,840
Tree Trimmers and Pruners	270	300	30	11.1%	$44,920
Veterinarians	490	540	50	10.2%	$81,950
Veterinary Assistants and Laboratory Animal Caretakers	970	1,090	120	12.4%	$26,150
Veterinary Technologists and Technicians	570	630	60	10.5%	$35,890
Zoologists and Wildlife Biologists	260	270	10	3.9%	$70,200

Source: Mississippi Department of Employment Security; mdes.ms.gov (2021).

Perkins V Requirements and Academic Infusion
The diversified agriculture mechanization core curriculum meets Perkins V requirements of introducing students to and preparing them for high-skill, high-wage occupations in agricultural fields. It also offers students a program of study, including secondary, postsecondary, and institutions of higher learning courses, that will further prepare them for careers in agriculture. Additionally, this curriculum is integrated with academic college- and career-readiness standards. Lastly, it focuses on ongoing and meaningful professional development for teachers as well as relationships with industry.

Transition to Postsecondary Education
The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website, mccb.edu.

Best Practices

Innovative Instructional Technologies
Classrooms should be equipped with tools that will teach today's digital learners through applicable and modern practices. The diversified agriculture educator's goal should be to include teaching strategies that incorporate current technology. To make use of the latest online communication tools—wikis, blogs, podcasts, and social media platforms, for example—the classroom teacher is encouraged to use a learning management system that introduces students to education in an online environment and places more of the responsibility of learning on the student.

Differentiated Instruction
Students learn in a variety of ways, and numerous factors—students' background, emotional health, and circumstances, for example—create unique learners. By providing various teaching and assessment strategies, students with various learning preferences can have more opportunity to succeed.

CTE Student Organizations
Teachers should investigate opportunities to sponsor a student organization. The National FFA Organization is the student organization for this pathway and will foster the types of learning expected from the diversified agriculture curriculum. FFA provides students with growth opportunities and competitive events and opens the doors to the world of agriculture and scholarship opportunities.

Cooperative Learning
Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The diversified agriculture curriculum provides opportunities for students to work together and help each other complete complex tasks. There are many field experiences within the curriculum that will allow and encourage collaboration with professionals currently in the agriscience field.

Work-Based Learning
Work-based learning is an extension of understanding competencies taught in the diversified agriculture classroom. This curriculum is designed in a way that necessitates active involvement by the students in the community around them and the global environment. These real-world connections and applications link to all types of students to knowledge, skills, and professional dispositions. Work-based learning should encompass ongoing and increasingly more complex involvement with local companies and agriscience professionals. Thus, supervised collaboration and immersion into the agriculture industry around the students are keys to students' success, knowledge, and skills development.

Professional Organizations

American Association for Agricultural Education (AAAE)
aaaeonline.org

Association for Career and Technical Education (ACTE)
acteonline.org

Mississippi ACTE
mississippiacte.com

Mississippi FFA/ Mississippi Association of Vocational Agriculture Teachers (MAVAT)
mississippiffa.org

National FFA Organization
ffa.org

National Association of Agricultural Educators (NAAE)
naae.org

Using This Document

Competencies and Suggested Objectives
A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Teacher Resources
Teacher resources for this curriculum may be found in multiple places. Many program areas have teacher resource documents that accompany the curriculum and can be downloaded from the same site as the curriculum. The teacher resource document contains references, lesson ideas, websites, teaching and assessment strategies, scenarios, skills to master, and other resources divided by unit. This document could be updated periodically by RCU staff. Please check the entire document, including the entries for each unit, regularly for new information. If you have something you would like to add or have a question about the document, call or email the RCU's instructional design specialist for your program. The teacher resource document can be downloaded at rcu.msstate.edu/curriculum/curriculumdownload.aspx. All teachers should request to be added to the Canvas Resource Guide for their course. This is where all resources will be housed in the future if they are not already. To be added to the guide, send a Help Desk ticket to the RCU by emailing helpdesk@rcu.msstate.edu.

Perkins V Quality Indicators and Enrichment Material
Some of the units may include an enrichment section at the end. If the diversified agriculture mechanization core program is currently using the Mississippi Career Planning and Assessment System (MS-CPAS) as a measure of accountability, the enrichment section of material will not be tested. If this is the case, it is suggested to use the enrichment material when needed or desired by the teacher and if time allows in the class. This material will greatly enhance the learning experiences for students. If, however, the diversified agriculture mechanization core program is using a national certification, work-based learning, or other measure of accountability that aligns with Perkins V as a quality indicator, this material could very well be tested on that quality indicator. It is the responsibility of the teacher to ensure all competencies for the selected quality indicator are covered throughout the year.

Unit 1: Leadership and SAE For All

Competencies and Suggested Objectives

1. Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration. DOK3
   a. Actively participate in FFA activities.
      - Leadership Development Events (LDE)
      - Career Development Events (CDE)
        - Agricultural Mechanization Technology Systems
      - Tractor operations and maintenance contest
      - Arc welding contest
      - Leadership retreats or conferences
      - Industry-related seminars, workshops, or conferences
      - Other related FFA activities

2. Identify potential college and career opportunities in agricultural mechanics. DOK1
   a. Research postsecondary institutions that offer studies in agricultural mechanics or a related field and prepare a two- to three-minute speech on their programs and potential career choices.
   b. Complete applications for college admission and scholarships.
   c. Revise a personal résumé for the purpose of applying for a specific job.
   d. Complete a job application for employment.
   e. Participate in a mock or real interview.

3. Review the types of programs under Supervised Agricultural Experience (SAE) for All. DOK1
   a. Explore concepts of a Foundational SAE.
      - Career exploration and planning
      - Employability skills for college and career readiness
      - Personal financial management and planning
      - Workplace safety
      - Agricultural literacy
   b. Explore concepts of an Immersion SAE.
      - Placement/internship
      - Ownership/entrepreneurship
      - Research
        - Experimental
        - Analytical
        - Invention
      - School-based enterprise
      - Service learning

4. Review individual plans for student Foundational SAE programs. DOK2
   a. Assess goal attainment in SAE from the previous year.
   b. Review and update short- and long-range goals pertaining to the SAE program.

5. Develop an Immersion SAE and maintain agricultural records. DOK2
   a. Redefine and adjust requirements of agreements between the student, parents, supervisor, and/or employer.
   b. Utilize an electronic/computer-based system of record keeping.
   c. Update SAE records.
      - SAE program goals
      - Student inventory related to the SAE program
      - Expense records
      - Income/gift and scholarship records
      - Skill-attainment records
      - Leadership-activity records and participation in FFA activities
      - Community service hours
   d. Complete degree and proficiency award applications as they apply to the SAE.

Unit 2: Introduction to Agricultural Mechanization

Competencies and Suggested Objectives
1. Investigate the role of mechanical technology in agriculture. DOK1 a. Discuss how mechanization and technology have changed the production of food and fiber. b. Describe the role of emerging technologies in agricultural mechanization. • Computers • Satellite Global Positioning System (GPS) signals • Geographic Information Systems (GIS) • Unmanned aerial vehicles and remote sensing through satellite imagery • Variable-rate technology • Yield mapping • Auto steering c. Define power and discuss how it is generated and measured. d. Describe the sources of power used in agricultural mechanization and associate each course with common applications. • Internal combustion engine • Electric motor • Hydraulic systems • Pneumatic systems
2. Perform basic measurements to applications in agricultural mechanization technology. DOK2 a. Read a standard and metric ruler or tape measure as it applies to linear measurement. b. Use graduated containers to measure and calculate amounts of standard and metric liquid measurements. c. Use a speed/combination square to measure and mark angles. d. Apply measuring skills to build a student-made project (e.g., toolbox, chicken tractor, dog box, etc.).
3. Identify physical science applications in agricultural mechanization technology. DOK2 a. Name the six simple machines and describe applications in agricultural mechanization for each machine. • Screw • Lever • Pulley • Wedge • Incline plane • Wheel and axle b. Calculate the mechanical advantage of a simple machine, such as a lever, pulley, or wedge.

Unit 3: Safety Applications in Agricultural Mechanization

Competencies and Suggested Objectives
1. Conduct agricultural workplace safety inspections to Occupational Safety and Health Administration (OSHA) standards. [DOK2] a. Discuss the risks associated with working in the agricultural industry. b. List OSHA guidelines related to work settings in agriculture.
2. Demonstrate safety procedures associated with equipment and tools in the agricultural mechanization workplace. [DOK2] a. Apply procedures for working in and maintaining a safe, orderly workplace. b. Describe work site and laboratory organization. c. Demonstrate safe use of personal protective equipment (PPE). • Safety glasses, goggles, and face shields • Protective clothing ○ Coveralls ○ Aprons ○ Shop coats ○ Footwear ○ Gloves ○ Hardhats ○ Masks and respirators ○ Earmuffs and earplugs d. Demonstrate rules for hand and power tools, including basic operation, safeguards in place, danger points, observer safety, fire safety, and electrical safety. e. Demonstrate safety rules and guidelines related to the operation and maintenance of agricultural equipment, including power machinery and implements.

Note: Safety is to be taught as an ongoing part of the program. Students are required to complete a written safety test with 100% accuracy before entering the shop for lab simulations and projects. This test should be documented in each student's file.
Note: This unit will be ongoing throughout the year. Time allotted for this unit will be distributed over the entire year.

Unit 4: Principles of Welding

Competencies and Suggested Objectives

1. Describe basic equipment, operations, and procedures, including safety precautions, of arc welding. DOK2
   a. Identify and describe the function and use of PPE and apparel (e.g., clothing, gloves, helmets, safety glasses/goggles).
   b. Discuss and demonstrate the safety procedures used to prevent electrical shock, eye and skin damage, and respiratory damage while welding.
   c. List the three major types of welding used in agricultural equipment repair and fabrication and discuss their characteristics and applications.
      - Shielded metal arc welding (SMAW)
      - Gas metal arc welding (GMAW) or metal inert gas (MIG)
      - Gas tungsten arc welding (GTAW) or tungsten inert gas (TIG)
   d. Describe the purpose/function of tools and accessories used in welding.
      - Electrode holder
      - Ground clamp
      - Cables
      - Electrodes
      - Wire
      - Chipping hammer
      - Wire brush
   e. Associate common SMAW electrodes and GMAW wire with their weld characteristics and proper use.
   f. Examine the relationship of amperage, voltage, and electrode type and diameter to electrode and metal type and thickness.
   g. Discuss common GMAW shielding gases.
   h. Identify the two types of welds (i.e., fillet [F] and groove [G]).
   i. Identify the difference between a stringer bead and a weave bead.
   j. Identify the five different types of weld joints.
      - Butt
      - Lap
      - T-weld
      - Corner
      - Edge
   k. Compare welding procedures for welding in different welding positions.
      - 1-Flat
      - 2-Horizontal
      - 3-Vertical
      - 4-Overhead
   l. Identify weld symbols as they are incorporated into plans and/or drawings (e.g., 1G is a flat-groove weld, 2F is a horizontal-fillet weld).

2. Perform welding techniques using SMAW and metal inert gas MIG.[DOK2]
   a. Demonstrate the procedure for striking an arc and running a flat bead.
   b. Construct a flat-butt weld.
   c. Construct a flat-fillet weld.
   d. Demonstrate the procedure for striking an arc and running a vertical up- and horizontal up-butt weld.
   e. Demonstrate the procedure for striking an arc and running a vertical up- and horizontal up-fillet weld.

Unit 5: Oxyfuel Cutting and Welding and Plasma-Cutting Operations

Competencies and Suggested Objectives
1. Describe and demonstrate principles of oxyfuel, brazing, and cutting procedures. DOK2 a. Describe and apply safety procedures and PPE for oxyfuel cutting. b. Identify and describe the function of the different parts of the oxyfuel cutting unit. • Cart • Cylinder • Regulators/gauges • Hoses • Torch body • Brazing, cutting, heating, and welding tips c. Set up, ignite, and shut down oxyfuel cutting equipment. d. Describe the characteristics and uses of the different oxyfuel flames (i.e., neutral, oxidizing, and carbonizing). e. Demonstrate how to make a cut in a mild steel plate.
2. Describe and demonstrate principles of plasma-cutting procedures. DOK2 a. Describe and apply safety procedures and PPE for plasma cutting. b. Identify and describe the function of the different parts of the plasma-cutting unit. • Machine • Compressed air/gas • Electrode • Torch body • Cutting tip • Ground cable and clamp c. Set up, ignite, and shut down plasma-cutting equipment. d. Describe the characteristics and uses of the plasma-cutting machine. e. Demonstrate how to make a cut in a mild steel plate.
3. Apply skills in welding to complete a welding project (e.g., metal gate, grooming stand, small grill, etc.). DOK3

Unit 6: Hydraulic and Pnuematic Systems in Agriculture

Competencies and Suggested Objectives
1. Explore principles of hydraulics and pneumatics. DOK2 a. Identify major components and the purpose and function of hydraulic and pneumatic systems. • Reservoir • Pump • Control valves • Check valves • Filter • Lines • Cylinders (single and double action) • Compressors (single spring and double spring action) • Lever • Pressure gauges b. Describe and apply Pascal's law and Boyle's law. c. Compare and contrast the operation of a pneumatic system to the operation of a hydraulic system. d. Demonstrate the operation of a pneumatic system to perform work. e. Demonstrate the operation of a hydraulic system to perform work.

Unit 7: Electrical Systems Applications in Agriculture

Competencies and Suggested Objectives
1. Describe and apply the use of electrical components and systems in agricultural equipment.[DOK2] a. Identify common symbols, schematics, and drawings of electrical systems. • Fuse • Circuit breaker • Battery • Relay • Ammeter • Resistor • Push-button switch • Single-receptacle outlet • Single-pole switch • Double-pole switch • Three-way switch • Ground connection • Wire identification, type, and size codes • Schematic for a branch circuit b. Measure resistance, voltage, and current in circuits using multimeter. c. Calculate resistance, voltage, and current in circuits using Ohm's law. d. Compare the functions of basic electrical devices. • Conductors • Switches • Service entrance panel • Breaker • Receptacle • Light
2. Explore the functions of basic electric and electronic devices (e.g., conductors, switches, etc.). [DOK1]
3. Apply electrical wiring and troubleshooting skills to successfully wire a three-way switch with a light receptacle. [DOK3]

Unit 8: Principles of Engines

Competencies and Suggested Objectives
1. Describe the functions and operations of major systems of a small gasoline engine. DOK2 a. Discuss and apply safety principles while working on engines. b. Describe the basic principles of combustion and force as applied to an internal combustion engine. c. Compare and contrast the operating principles of four- and two-stroke gasoline engines. d. Compare and contrast the operating principles of gasoline and diesel engines. e. Describe the types of the lubrication systems. • Splash • Pressurized (e.g., plunger and rotary) f. Select proper lubricants and fuels based on the manufacturer's recommendation. g. Describe the types of air- and liquid-cooled engine cooling systems. • Air-cooling fins • Liquid cooled o Water pump o Radiator cap o Radiator o Thermostat h. Describe the parts and function of a small gasoline engine fuel system. • Carburetor • Tank • Pump/gravity flow • Filter i. Describe the parts and functions of a small gasoline engine ignition system. • Spark plug • Ignition coil • Switch • Power source (battery pull rope)
2. Investigate the functions and operations of major systems of a diesel engine and compare them to a small gasoline engine. DOK2 a. Discuss and apply safety principles while working on engines. b. Describe the basic principles of combustion and force as applied to an internal combustion diesel engine.
3. Disassemble, inspect, and reassemble a small gasoline engine. DOK3 a. Disassemble a small gasoline engine, including removing the head, oil pan, piston and crankshaft assembly, and valves. b. Inspect and measure parts of the engine to verify it is within the tolerances set by the manufacturer. c. Reassemble the engine and test for proper operation (e.g., compression, ignition).

Unit 9: Management and Operation of Agricultural Equipment

Competencies and Suggested Objectives

1. Describe the importance of machinery management and maintenance. DOK1
2. Demonstrate the proper safety principles and operational skills for mechanized agricultural equipment. DOK2
   a. Identify common equipment controls and describe their use and function.
      - Throttle
      - Clutch
      - Brakes
      - Hydraulic valves
      - Transmission shift controls
   b. Demonstrate the procedures for pre-inspection and start-up of an internal combustion engine.
      - Locate and interpret operation procedures in the owner's manual.
      - Observe or operate any locally available equipment in a safe and proper manner, including driving, backing two-wheeled equipment, and properly hitching to selected equipment
      - Check the oil level.
      - Check the fuel level.
      - Check the fuel shutoff valve.
      - Check for obstructions.
      - Check the coolant fluid level if liquid cooled, the fins if air cooled.
      - Check the tire inflation.
      - Check the brakes.
      - Check the clutch.
      - Adjust the seat and seat belt.
      - Adjust the steering.
      - Check the throttle.
        - Operation inspection
      - Oil pressure
      - Ammeter
      - Temperature
      - Fuel level (operation)
      - Wear a seat belt.
      - Clutch engagement
      - Clean gear shifting
      - Avoid stalling the engine.
      - Avoid excessive engine speed.
      - Avoid excessive speed.
      - Avoid unsafe conduct during operation.

3. Demonstrate recommended maintenance practices for agricultural equipment. DOK3
   a. Discuss the meaning of *preventative maintenance*.
   b. Locate and interpret preventative maintenance information in the owner's manual.
   c. Perform maintenance routines.
      - Inspect and service the air cleaner.
      - Inspect and service the lubrication system.
      - Inspect and service the fuel system.
      - Inspect and service belts and hoses.
      - Inspect and service a liquid coolant system.
   d. Complete a work order for a given repair or maintenance procedure and calculate the cost of the repair.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Leadership and SAE for All		
	1.	Participate in local, state, and/or national FFA activities that provide opportunities for leadership development and career exploration.
	2.	Identify potential college and career opportunities in agricultural mechanics.
	3.	Review the types of programs under SAE for All.
	4.	Review individual plans for student Foundational SAE programs.
	5.	Develop an Immersion SAE and maintain agricultural records.
Unit 2: Introduction to Agricultural Mechanization		
	1.	Investigate the role of mechanical technology in agriculture.
	2.	Perform basic measurements to applications in agricultural mechanization technology.
	3.	Identify physical science applications in agricultural mechanization technology.
Unit 3: Safety Applications in Agricultural Mechanization		
	1.	Conduct agricultural workplace safety inspections to Occupational Safety and Health Administration (OSHA) standards.
	2.	Demonstrate safety procedures associated with equipment and tools in the agricultural mechanization workplace.
Unit 4: Principles of Welding		
	1.	Describe basic equipment, operations, and procedures, including safety precautions, of arc welding.
	2.	Perform welding techniques using SMAW and metal inert gas MIG.
Unit 5: Oxyfuel Cutting and Welding and Plasma-Cutting Operations		
	1.	Describe and demonstrate principles of oxyfuel, brazing, and cutting procedures.
	2.	Describe and demonstrate principles of plasma-cutting procedures.
	3.	Apply skills in welding to complete a welding project (e.g., metal gate, grooming stand, small grill, etc.).
Unit 6: Hydraulic and Pneumatic Systems in Agriculture		
	1.	Explore principles of hydraulics and pneumatics.
Unit 7: Electrical Systems Applications in Agriculture		

	1.	Describe and apply the use of electrical components and systems in agricultural equipment.
	2.	Explore the functions of basic electric and electronic devices (e.g., conductors, switches, etc.).
	3.	Apply electrical wiring and troubleshooting skills to successfully wire a three-way switch with a light receptacle.
Unit 8: Principles of Engines		
	1.	Describe the functions and operations of major systems of a small gasoline engine.
	2.	Investigate the functions and operations of major systems of a diesel engine and compare to a small gasoline engine.
	3.	Disassemble, inspect, and reassemble a small gasoline engine.
Unit 9: Management and Operation of Agricultural Equipment		
	1.	Describe the importance of machinery management and maintenance.
	2.	Demonstrate the proper safety principles and operational skills for mechanized agricultural equipment.
	3.	Demonstrate recommended maintenance practices for agricultural equipment.

Appendix: Industry Standards

Framework for AFNR Content Standards and Performance Elements Crosswalk for Diversified Agriculture Mechanization Core

	Unit	1	2	3	4	5	6	7	8	9
AFNR										
ABS- Agribusiness Systems		X								
AS- Animal Systems										
BS- Biotechnology										
CRP- Career Ready Practices		X	X	X	X	X	X	X	X	X
CS- AFNR Cluster Skill		X	X	X	X	X	X	X	X	X
ES- Environmental Service Systems										
FPP- Food Products and Processing Systems										
NRS- Natural Resource Systems										
PS- Plant Systems			X							
PST- Power, Structural, and Technical Systems		X	X	X	X	X	X	X	X	X

AFNR Pathway
Content Standards and Performance Elements

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ABS AGRIBUSINESS SYSTEMS
AS ANIMAL SYSTEMS
BS BIOTECHNOLOGY
CRP CAREER READY PRACTICES
CS AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL
ES ENVIRONMENTAL SERVICE SYSTEMS
FPP FOOD PRODUCTS AND PROCESSING SYSTEMS
NRS NATURAL RESOURCE SYSTEMS
PS PLANT SYSTEMS
PST POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

Agribusiness Systems Career Pathway Content Standards

The Agribusiness Systems (ABS) Career Pathway encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), and business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application and management of agribusiness systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.

ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.

ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.

ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.

ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.

ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).

ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.

ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.

ABS.04. CCTC Standard: Develop a business plan for an AFNR business.

ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.

ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Animal Systems Career Pathway Content Standards

The Animal Systems (AS) Career Pathway encompasses the study of animal systems, including content areas such as life processes, health, nutrition, genetics, and management and processing, as applied to small animals, aquaculture, exotic animals, livestock, dairy, horses and/or poultry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of animal systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Animal Systems (AG-AS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

AS.01. CCTC Standard: Analyze historic and current trends impacting the animal systems industry.

AS.01.01. Performance Indicator: Evaluate the development and implications of animal origin, domestication and distribution on production practices and the environment.

AS.01.02. Performance Indicator: Assess and select animal production methods for use in animal systems based upon their effectiveness and impacts.

AS.01.03. Performance Indicator: Analyze and apply laws and sustainable practices to animal agriculture from a global perspective.

AS.02. CCTC Standard: Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.

AS.02.01. Performance Indicator: Demonstrate management techniques that ensure animal welfare.

AS.02.02. Performance Indicator: Analyze procedures to ensure that animal products are safe for consumption (e.g., use in food system, etc.).

AS.03. CCTC Standard: Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.

AS.03.01. Performance Indicator: Analyze the nutritional needs of animals.

AS.03.02 Performance Indicator: Analyze feed rations and assess if they meet the nutritional needs of animals.

AS.03.03 Performance Indicator: Utilize industry tools to make animal nutrition decisions.

AS.04. CCTC Standard: Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.

AS.04.01. Performance Indicator: Evaluate animals for breeding readiness and soundness.

AS.04.02. Performance Indicator: Apply scientific principles to select and care for breeding animals.

AS.04.03 Performance Indicator: Apply scientific principles to breed animals.

AS.05. CCTC Standard: Evaluate environmental factors affecting animal performance and implement procedures for enhancing performance and animal health.

AS.05.01. Performance Indicator: Design animal housing, equipment and handling facilities for the major systems of animal production.

AS.05.02. Performance Indicator: Comply with government regulations and safety standards for facilities used in animal production.

AS.06. CCTC Standard: Classify, evaluate and select animals based on anatomical and physiological characteristics.

AS.06.01. Performance Indicator: Classify animals according to taxonomic classification systems and use (e.g. agricultural, companion, etc.).

AS.06.02. Performance Indicator: Apply principles of comparative anatomy and physiology to uses within various animal systems.

AS.06.03. Performance Indicator: Select and train animals for specific purposes and maximum performance based on anatomy and physiology.

AS.07. CCTC Standard: Apply principles of effective animal health care.

AS.07.01. Performance Indicator: Design programs to prevent animal diseases, parasites and other disorders and ensure animal welfare.

AS.07.02. Performance Indicator: Analyze biosecurity measures utilized to protect the welfare of animals on a local, state, national, and global level.

AS.08. CCTC Standard: Analyze environmental factors associated with animal production.

AS.08.01. Performance Indicator: Design and implement methods to reduce the effects of animal production on the environment.

AS.08.02. Performance Indicator: Evaluate the effects of environmental conditions on animals and create plans to ensure favorable environments for animals.

Common Career Technical Core Career Ready Practices Content Standards

The CCTC CRPs encompass fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical-thinking, problem solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency. Students completing a program of study in any AFNR career pathway will demonstrate the knowledge, skills and behaviors that are important to career ready through experiences in a variety of settings (e.g., classroom, CTSO, work-based learning, community etc.).

DEFINITIONS: Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a CTE program of study.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

CRP.02.01. Performance Indicator: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.

CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.

CRP.10.03. Performance Indicator: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

CRP.11.02. Performance Indicator: Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.

CRP.12.01. Performance Indicator: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.

CRP.12.02. Performance Indicator: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

The AFNR Cluster Skills (CS) encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career

pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** –These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

CS.01. CCTC Standard: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

- **CS.01.01. Performance Indicator:** Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
- **CS.01.02. Performance Indicator:** Examine technologies and analyze their impact on AFNR systems.
- **CS.01.03. Performance Indicator:** Identify public policies and examine their impact on AFNR systems.

CS.02. CCTC Standard: Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.

- **CS.02.01. Performance Indicator:** Research and use geographic and economic data to solve problems in AFNR systems.
- **CS.02.02. Performance Indicator:** Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

- **CS.03.01. Performance Indicator:** Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
- **CS.03.02. Performance Indicator:** Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.
- **CS.03.03. Performance Indicator:** Apply health and safety practices to AFNR workplaces.
- **CS.03.04. Performance Indicator:** Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.
CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.
CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.
CS.05.01. Performance Indicator: Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).

CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.
CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.
CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Biotechnology Systems Career Pathway Content Standards

The Biotechnology Systems (BS) Career Pathway encompasses the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of biotechnology in the context of AFNR.

Within each pathway, the standards are organized as follows:

- ***National Council for Agricultural Education (NCAE) Standard**** – These are the standards set forth by the National Council for Agricultural Education for Biotechnology Systems. They define what students should know and be able to do after completing instruction in a program of study focused on applying biotechnology to AFNR systems.
- ***Performance Indicators*** – These statements distill each performance element into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related performance element at the conclusion of a program of study in this area.

BS.01. NCAE Standard: Assess factors that have influenced the evolution of biotechnology in agriculture (e.g., historical events, societal trends, ethical and legal implications, etc.).
BS.01.01. **Performance Indicator**: Investigate and explain the relationship between past, current and emerging applications of biotechnology in agriculture (e.g., major innovators, historical developments, potential applications of biotechnology, etc.).

BS.01.02. Performance Indicator: Evaluate the scope and implications of regulatory agencies on applications of biotechnology in agriculture and protection of public interests (e.g., health, safety, environmental issues, etc.).

BS.01.03. Performance Indicator: Analyze the relationship and implications of bioethics, laws and public perceptions on applications of biotechnology in agriculture (e.g., ethical, legal, social, cultural issues).

BS.02. NCAE Standard: Demonstrate proficiency by safely applying appropriate laboratory skills to complete tasks in a biotechnology research and development environment (e.g., standard operating procedures, record keeping, aseptic technique, equipment maintenance, etc.).

BS.02.01. **Performance Indicator**: Read, document, evaluate and secure accurate laboratory records of experimental protocols, observations and results.

BS.02.02. Performance Indicator: Implement standard operating procedures for the proper maintenance, use and sterilization of equipment in a laboratory.

BS.02.03. Performance Indicator: Apply standard operating procedures for the safe handling of biological and chemical materials in a laboratory.

BS.02.04. Performance Indicator: Safely manage and dispose of biological materials, chemicals and wastes according to standard operating procedures.

BS.02.05. Performance Indicator: Examine and perform scientific procedures using microbes, DNA, RNA and proteins in a laboratory.

BS.03. NCAE Standard: Demonstrate the application of biotechnology to solve problems in Agriculture, Food and Natural Resources (AFNR) systems (e.g., bioengineering, food processing, waste management, horticulture, forestry, livestock, crops, etc.).

BS.03.01. Performance Indicator: Apply biotechnology principles, techniques and processes to create transgenic species through genetic engineering.

BS.03.02. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance the production of food through the use of microorganisms and enzymes.

BS.03.03. Performance Indicator: Apply biotechnology principles, techniques and processes to protect the environment and maximize use of natural resources (e.g., biomass, bioprospecting, industrial biotechnology, etc.).

BS.03.04. Performance Indicator: Apply biotechnology principles, techniques and processes to enhance plant and animal care and production (e.g., selective breeding, pharmaceuticals, biodiversity, etc.).

BS.03.05. Performance Indicator: Apply biotechnology principles, techniques and processes to produce biofuels (e.g., fermentation, transesterification, methanogenesis, etc.).

BS.03.06. Performance Indicator: Apply biotechnology principles, techniques and processes to improve waste management (e.g., genetically modified organisms, bioremediation, etc.).

Environmental Service Systems Career Pathway Content Standards

The Environmental Service Systems (ESS) Career Pathway encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of environmental service systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Environmental Service Systems (AG-ESS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

ESS.01. CCTC Standard: Use analytical procedures and instruments to manage environmental service systems.

ESS.01.01. Performance Indicator: Analyze and interpret laboratory and field samples in environmental service systems.

ESS.01.02. Performance Indicator: Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments, etc.).

ESS.02. CCTC Standard: Evaluate the impact of public policies and regulations on environmental service system operations.

ESS.02.01. Performance Indicator: Interpret and evaluate the impact of laws, agencies, policies and practices affecting environmental service systems.

ESS.02.02. Performance Indicator: Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade, etc.).

ESS.02.03. Performance Indicator: Examine and summarize the impact of public perceptions and social movements on the regulation of environmental service systems.

ESS.03. CCTC Standard: Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry and ecology.

ESS.03.01. Performance Indicator: Apply meteorology principles to environmental service systems.

ESS.03.02. Performance Indicator: Apply soil science and hydrology principles to environmental service systems.

ESS.03.03. Performance Indicator: Apply chemistry principles to environmental service systems.

ESS.03.04. Performance Indicator: Apply microbiology principles to environmental service systems.

ESS.03.05. Performance Indicator: Apply ecology principles to environmental service systems.

ESS.04. CCTC Standard: Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management and energy conservation).

ESS.04.01. Performance Indicator: Use pollution control measures to maintain a safe facility and environment.

ESS.04.02. Performance Indicator: Manage safe disposal of all categories of solid waste in environmental service systems.

ESS.04.03. Performance Indicator: Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

ESS.04.04. Performance Indicator: Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

ESS.05. CCTC Standard: Use tools, equipment, machinery and technology common to tasks in environmental service systems.

ESS.05.01. Performance Indicator: Use technological and mathematical tools to map land, facilities and infrastructure for environmental service systems.

ESS.05.02. Performance Indicator: Perform assessments of environmental conditions using equipment, machinery and technology.

Food Products and Processing Systems Career Pathway Content Standards

The Food Products and Processing Systems (FPP) Career Pathway encompasses the study of food safety and sanitation; nutrition, biology, microbiology, chemistry and human behavior in local and global food systems; food selection and processing for storage, distribution and consumption; and the historical and current development of the food industry. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of food products and processing systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Food Products and Processing Systems (AG-FPP) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to

demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

FPP.01. CCTC Standard: Develop and implement procedures to ensure safety, sanitation and quality in food product and processing facilities.

FPP.01.01. Performance Indicator: Analyze and manage operational and safety procedures in food products and processing facilities.

FPP.01.02. Performance Indicator: Apply food safety and sanitation procedures in the handling and processing of food products to ensure food quality.

FPP.01.03. Performance Indicator: Apply food safety procedures when storing food products to ensure food quality.

FPP.02. CCTC Standard: Apply principles of nutrition, biology, microbiology, chemistry and human behavior to the development of food products.

FPP.02.01. Performance Indicator: Apply principles of nutrition and biology to develop food products that provide a safe, wholesome and nutritious food supply for local and global food systems.

FPP.02.02. Performance Indicator: Apply principles of microbiology and chemistry to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

FPP.02.03. Performance Indicator: Apply principles of human behavior to develop food products to provide a safe, wholesome and nutritious food supply for local and global food systems.

FPP.03. CCTC Standard: Select and process food products for storage, distribution and consumption.

FPP.03.01. Performance Indicator: Implement selection, evaluation and inspection techniques to ensure safe and quality food products.

FPP.03.02. Performance Indicator: Design and apply techniques of food processing, preservation, packaging and presentation for distribution and consumption of food products.

FPP.03.03. Performance Indicator: Create food distribution plans and procedures to ensure safe delivery of food products.

FPP.04. CCTC Standard: Explain the scope of the food industry and the historical and current developments of food product and processing.

FPP.04.01. Performance Indicator: Examine the scope of the food industry by evaluating local and global policies, trends and customs for food production.

FPP.04.02. Performance Indicator: Evaluate the significance and implications of changes and trends in the food products and processing industry in the local and global food systems.

FPP.04.03. Performance Indicator: Identify and explain the purpose of industry organizations, groups and regulatory agencies that influence the local and global food systems.

Natural Resource Systems Career Pathway Content Standards

The Natural Resource Systems (NRS) Career Pathway encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of natural resource systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Natural Resource Systems (AG-NRS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

NRS.01. CCTC Standard: Plan and conduct natural resource management activities that apply logical, reasoned and scientifically based solutions to natural resource issues and goals.

NRS.01.01. Performance Indicator: Apply methods of classification to examine natural resource availability and ecosystem function in a particular region.

NRS.01.02. Performance Indicator: Classify different types of natural resources in order to enable protection, conservation, enhancement and management in a particular geographical region.

NRS.01.03. Performance Indicator: Apply ecological concepts and principles to atmospheric natural resource systems.

NRS.01.04. Performance Indicator: Apply ecological concepts and principles to aquatic natural resource systems.

NRS.01.05. Performance Indicator: Apply ecological concepts and principles to terrestrial natural resource systems.

NRS.01.06. Performance Indicator: Apply ecological concepts and principles to living organisms in natural resource systems.

NRS.02. CCTC Standard: Analyze the interrelationships between natural resources and humans.

NRS.02.01. Performance Indicator: Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy, etc.).

NRS.02.02. Performance Indicator: Assess the impact of human activities on the availability of natural resources.

NRS.02.03. Performance Indicator: Analyze how modern perceptions of natural resource management, protection, enhancement and improvement change and develop over time.

NRS.02.04. Performance Indicator: Examine and explain how economics affects the use of natural resources.

NRS.02.05. Performance Indicator: Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

NRS.03. CCTC Standard: Develop plans to ensure sustainable production and processing of natural resources.

NRS.03.01. Performance Indicator: Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species, etc.).

NRS.03.02. Performance Indicator: Demonstrate cartographic skills, tools and technologies to aid in developing, implementing and evaluating natural resource management plans.

NRS.04. CCTC Standard: Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

NRS.04.01. Performance Indicator: Demonstrate natural resource protection, maintenance, enhancement and improvement techniques.

NRS.04.02. Performance Indicator: Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

NRS.04.03. Performance Indicator: Prevent or manage introduction of ecologically harmful species in a particular region.

NRS.04.04. Performance Indicator: Manage fires in natural resource systems.

Plant Science Systems Career Pathway Content Standards

The Plant Systems (PS) Career Pathway encompasses the study of plant life cycles, classifications, functions, structures, reproduction, media and nutrients, as wells as growth and cultural practices through the study of crops, turf grass, trees, shrubs and/or ornamental plants. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of plant systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Plant Systems (AG-PS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

PS.01. CCTC Standard: Develop and implement a crop management plan for a given production goal that accounts for environmental factors.

- **PS.01.01. Performance Indicator:** Determine the influence of environmental factors on plant growth.
- **PS.01.02. Performance Indicator:** Prepare and manage growing media for use in plant systems.
- **PS.01.03. Performance Indicator:** Develop and implement a fertilization plan for specific plants or crops.

PS.02. CCTC Standard: Apply principles of classification, plant anatomy, and plant physiology to plant production and management.

- **PS.02.01. Performance Indicator:** Classify plants according to taxonomic systems.
- **PS.02.02. Performance Indicator:** Apply knowledge of plant anatomy and the functions of plant structures to activities associated with plant systems.
- **PS.02.03. Performance Indicator:** Apply knowledge of plant physiology and energy conversion to plant systems.

PS.03. CCTC Standard: Propagate, culture and harvest plants and plant products based on current industry standards.

- **PS.03.01. Performance Indicator:** Demonstrate plant propagation techniques in plant system activities.
- **PS.03.02. Performance Indicator:** Develop and implement a management plan for plant production.
- **PS.03.03. Performance Indicator:** Develop and implement a plan for integrated pest management for plant production.
- **PS.03.04. Performance Indicator:** Apply principles and practices of sustainable agriculture to plant production.
- **PS.03.05. Performance Indicator:** Harvest, handle and store crops according to current industry standards.

PS.04. CCTC Standard: Apply principles of design in plant systems to enhance an environment (e.g. floral, forest landscape, and farm).

- **PS.04.01. Performance Indicator:** Evaluating, identifying and preparing plants to enhance an environment.
- **PS.04.02. Performance Indicator:** Create designs using plants.

Power, Structural and Technical Systems Career Pathway Content Standards

The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

PST.01. CCTC Standard: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

PST.01.01. Performance Indicator: Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.

PST.01.02. Performance Indicator: Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.

PST.01.03. Performance Indicator: Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

PST.02. CCTC Standard: Operate and maintain AFNR mechanical equipment and power systems.

PST.02.01. Performance Indicator: Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.

PST.02.02. Performance Indicator: Operate machinery and equipment while observing all safety precautions in AFNR settings.

PST.03. CCTC Standard: Service and repair AFNR mechanical equipment and power systems.

PST.03.01. Performance Indicator: Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.

PST.03.02. Performance Indicator: Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.

PST.03.03. Performance Indicator: Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).

PST.04. CCTC Standard: Plan, build and maintain AFNR structures.

PST.04.01. Performance Indicator: Create sketches and plans for AFNR structures.

PST.04.02. Performance Indicator: Determine structural requirements, specifications and estimate costs for AFNR structures

PST.04.03. Performance Indicator: Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

PST.04.04. Performance Indicator: Apply electrical wiring principles in AFNR structures.

PST.05. CCTC Standard: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.

PST.05.01. Performance Indicator: Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.

PST.05.02. Performance Indicator: Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.

PST.05.03. Performance Indicator: Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

2017 AEST Science of Agricultural Mechanization Level I

Program CIP: 01.0201 Agricultural Mechanization, General

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The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Standards

Standards are superscripted in each unit and are referenced in the appendices. Standards in the AEST Science of Agricultural Mechanization Curriculum Framework and Supporting Materials are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National Council for Agricultural Education (The Council) shapes and strengthens school-based agricultural education at all levels. The Council and the National AFNR Career Cluster Content Standards Committee have developed the career pathway content standards to outline technical knowledge and skills required for future success within Agriculture and Environmental Science and Technology. The content standards are intended to provide a forward-thinking guide for what students should know and be able to do after completing this program of study. The standards referenced in this curriculum are reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2015. https://www.ffa.org/thecouncil/afnr.

College and Career-Ready Standards

The College and Career-Ready Standards emphasize critical thinking, teamwork and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Ready Standards (MCCRS) because they provide a consistent, clear understanding of what students are expected to learn so that teachers and parents know what they need to do to help them. Reprinted from http://www.mde.k12.ms.us/MCCRS

International Society for Technology in Education Standards (ISTE)

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21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st-century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and information and communication technology (ICT) literacy.

Preface

Secondary career and technical education programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and Every Student Succeeds Act 2015.).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers.

Curriculum, Assessment, Professional Learning, and other program resources can be found at The Research and Curriculum Unit's website: http://www.rcu.msstate.edu

Should you need additional instructions regarding these resources, please call 662.325.2510.

The National FFA Organization website has educator resources, student organization guidelines and program information, professional organization information and experiential learning guidelines. All Agricultural Education teachers have been given free access to these resources at www.ffa.org.

Executive Summary

Pathway Description

AEST science of agricultural mechanization is one of the five pathway courses in the agricultural and environmental science and technology (AEST) program. All students must complete the Concepts of Agriscience course before being allowed to enroll in the advanced courses of the program, such as the Science of Agricultural Mechanization Level I course. This course within the agricultural mechanization pathway establishes basic skills in metal fabrication as it applies to an agricultural work environment. Students will attain basic skills in metal cutting and welding, which will lead to a more advanced skill set in the subsequent Level II course. Emphasis is on an active learning environment enriched with technology, engineering, and math-based applications. The course focuses on providing an opportunity for students to explore the different fields of the agricultural sciences and develop foundational skills and knowledge needed for advancement in other courses and programs. The course carries one-half Carnegie Unit of credit that can count toward high school graduation.

Industry Certification

No national industry-recognized certifications are known to exist at this time in the field of agriscience. Competencies and suggested performance indicators in the science of agricultural mechanization course have been correlated, however, to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Assessment

The latest assessment blueprint for the curriculum can be found at http://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx.

Student Prerequisites

In order for students to experience success in the program, the following student prerequisites are suggested:

1. C or higher in English (the previous year)
2. C or higher in math (last course taken, or the instructor can specify the math)
3. Instructor approval and TABE reading score (eighth grade or higher)

or

1. TABE reading score (eighth grade or higher)
2. Instructor approval

or

1. Instructor approval

Applied Academic Credit

The latest academic credit information can be found at http://www.mde.k12.ms.us/ACCRED/AAS.
Once there, click the "Mississippi Public School Accountability Standards Year" tab.
Review the appendices for graduation options and superscript information regarding specific programs receiving academic credit.

~~Check this site often as it is updated frequently.~~

~~Teacher Licensure~~

~~The latest teacher licensure information can be found at http://www.mde.k12.ms.us/educator-licensure.~~

~~Professional Learning~~

~~If you have specific questions about the content of any of training sessions provided, please contact the Research and Curriculum Unit at 662.325.2510.~~

Course Outlines

Course Description: The Science of Agricultural Mechanization Level I course establishes basic skills in metal fabrication as it applies to an agricultural work environment. Students will attain basic skills in metal cutting and welding, which will lead to a more advanced skill set in the subsequent Level II course. Emphasis is on an active learning environment enriched with technology, engineering, and math-based applications. The course serves as the Level I course for the Science of Agricultural Mechanization Level II course. The focus of this course is to begin the preparation of students for further study leading to successful careers in the agricultural industry.

Science of Agricultural Mechanization Level I (0.5 Carnegie Unit) - Course Code: 991012

Unit	Unit Name	Hours
1	Leadership and Experiential Learning (SAE)	8
2	Introduction to Agricultural Mechanization	17
3	Oxyacetylene/Plasmas Cutting Operations	22
4	Principles of Metal Fabrication (Arc Welding)	23
Total		70

Research Synopsis

Introduction

The agricultural sciences career cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Agriculture, during the next five years (2015-2020) 57,900 jobs are expected to open in food, agriculture, renewable natural resources, or the environment for graduates with bachelor's or higher degrees in those areas. Almost half of those jobs will be in management and business; 27% in science, technology, engineering, and math in agriculture; 15% in sustainable food and biomaterials production; and 12% in education, communication, and government services. According to U.S. Department of Agriculture (USDA) statistics, $167.3 billion was earned in agriculture, forestry, fishing, and hunting in the United States in 2014. The Mississippi Department of Agriculture and Commerce reports that agriculture is a $7.9 billion industry, employing approximately 29% of the state's workforce.

AEST programs target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (2015). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Occupation	Employment		Projected Growth 2010-2020		Average Wage 2015	
	Current (2010)	Projected (2020)	Number	Percent	Hourly	Annual
Agricultural and Food Science Technicians	190	200	10	5.3	$15.92	$33,120
Agricultural Equipment Operators	280	300	20	7.1	$17.32	$36,020
Conservation Scientists	1,270	1,330	60	4.7	$26.05	$54,190
Environmental Engineers	890	950	60	6.7	$34.70	$72,170
Environmental Engineering Technicians	100	110	10	10.0	$20.44	$42,510
Environmental Scientists and Specialists, Including Health	920	990	70	7.6	$27.02	$56,190
Environmental Science and Protection Technicians, Including Health	30	40	10	33.3	$19.73	$41,030
Soil and Plant Scientists	70	80	10	14.3	$39.74	$82,660

Farmworkers and Laborers, Crop, Nursery, and Greenhouse	690	690	0	0.0	$9.39	$19,540
Farmworkers, Farm and Ranch Animals	440	460	20	7.1	$10.17	$21,150
First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	300	310	10	3.3	$22.61	$47,030
Foresters	650	670	20	3.1	$52,660	$17.73
Forest and Conservation Workers	70	80	10	14.3	$20.26	$42,150
Veterinarians	430	520	90	20.9	$39.15	$81,440
Veterinary Assistants and Laboratory Animal Caretakers	580	580	0	0.0	$10.30	$21,430
Veterinary Technologists and Technicians	610	800	190	31.1	$15.13	$31,470

Source: Mississippi Department of Employment Security, www.mdes.ms.gov.

Perkins IV Requirements

Curriculum Content

In compiling the research for the agricultural sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agencies. The following comments summarize the results of these interviews:

Summary of Standards

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that students need to better develop skills related to leadership; teamwork; communication; and work ethic, habits, and values. All respondents also indicated that a basic knowledge of economics, record keeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or university level.
- All respondents agreed that a College and Career Ready foundation of knowledge and skills existed across all major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles

of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and agriculture and natural resources pathway.

- All respondents agreed that students in all pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should also be exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies, including the USDA, OSHA, FDA, and EPA, should be discussed. Also, the role of agricultural organizations, such as the Poultry Association, Nurseryman's Association, and Farm Bureau, needs to be investigated.

Academic Infusion

The AEST curriculum is tied to the Mississippi College- and Career-Ready Standards. The curriculum provides multiple opportunities to enhance and reinforce these academic skills. Because students will be required to communicate effectively in the classroom as well as in the workforce, there is a considerable amount of reading and writing in this curriculum. Overall, the AEST curriculum requires students to make presentations, read technical manuals, and use strategic and critical-thinking skills to solve real-world problems. The location of the College- and Career-Ready Standards for each unit is located in Appendix E.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website http://www.mccb.edu/.

Best Practices

The premise of the success of all school-based, agricultural-education programs is focused on the implementation of the three-circle model, which depicts the three major components of the program interlocked and working together as one. The three components are classroom and laboratory instruction, experiential learning through supervised agricultural experience (SAE) programs for individual students, and participation in the CTE student organization for agriculture education, the National FFA organization.

Classroom and Laboratory Instruction

The classroom and laboratory component of the school-based, agricultural-education, three-circle model is the foundation of the success of the other two components. Through contextual learning, students in agricultural education can learn the science, business, and technology of modern agriculture through innovative instructional technologies, differentiated instruction, and cooperative learning.

Innovative Instructional Technologies

Recognizing that today's students are digital learners, the classroom should be equipped with tools that will teach them in the way they need to learn. The AEST teacher's goal should be to include teaching strategies that incorporate current technology. It is suggested that each classroom house a classroom set of smart tablets and one teacher laptop. To make use of the latest online communication tools, such as wikis, blogs, and podcasts, the teacher is encouraged to use a learning-management system that introduces students to teaching and learning strategies in an online environment and places the responsibility of learning on the student.

Differentiated Instruction

All students are unique and possess an individualized learning style. Differentiated instruction is an approach to teaching that addresses the differences in learning styles by providing alternative teaching and assessment methods that reach across the spectrum of student needs in the classroom. By differentiating instruction in AEST, teachers can more effectively reach students and address their strengths and weaknesses, therefore increasing student success. The implementation of various forms of technology; the of alternative assessments, such as rubrics and problem-based assessment; and utilizing hands-on and work-based learning opportunities in the program of instruction truly enhance the quality of the curriculum presentation.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the science of agricultural mechanization curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The science of agricultural mechanization curriculum provides opportunities for students to work together and help each other complete complex tasks.

Experiential Learning (SAE)

The experiential learning (SAE) component has long been an integral part of the school-based, agricultural education, three-component model. Each student is encouraged to explore their career interests and plan an experiential, service, and/or work-based learning program to guide them to their career goals. This SAE program guides the student as they maintain a record-keeping system of the time and money invested, as well as the skills gained from their experiences. The experiential learning projects can be used in a variety of situations to reinforce and complement classroom theory and content. The experiential learning project consists of entrepreneurship, placement, research/experimentation, and exploratory discovery and spans the duration of program enrollment.

CTE Student Organizations

As the third part of the school-based, agricultural education program, the FFA component is the showcase, or focal point, of leadership, growth, and development for students. The FFA is the student organization for the science of agricultural mechanization curriculum. The FFA offers many opportunities for student success, such as leadership development, career development events, degrees of attainment, awards and scholarships, and community service. The FFA provides students with growth opportunities and competitive events. It also opens the doors to the world of agriculture and scholarship opportunities.

Conclusion

The AEST curriculum is one of Mississippi's most comprehensive agriculture curricula. It is a systematic program of instruction, and students who complete this program are well equipped for a variety of careers and the ability to make informed choices regarding food, fiber, and managing natural resources. Instructors are urged to encourage AEST science of agricultural mechanization students to pursue postsecondary educational opportunities at community colleges and universities in Mississippi.

Professional Organizations

Agricultural Education Division of the Association for Career and Technical Education. May be found online at http://www.acteonline.org/

American Association for Agricultural Education. May be found online at http://aaaeonline.org/

Mississippi ACTE. May be found online at http://www.mississippiacte.com/

Mississippi Association of Vocational Agriculture Teachers (MAVAT). May be found online at www.mississippiffa.org

National Association of Agricultural Educators. May be found online at http://www.naae.org/

National Association of Supervisors of Agricultural Education. May be found online at https://www.ffa.org/thecouncil/nasae/

National FFA Alumni Association. May be found online at https://www.ffa.org/getinvolved/alumni/

National FFA Foundation, Inc. May be found online at https://www.ffa.org/support/foundation/

National Farm and Ranch Business Management Education Association. May be found online at http://www.nfrbmea.org/

National Postsecondary Agricultural Student Organization. May be found online at http://www.nationalpas.org/

National Young Farmer Educational Association. May be found online at http://www.nyfea.org

Using This Document

Suggested Time on Task

This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

Unit 1: Leadership and Experiential Learning (SAE)

Competencies and Suggested Objectives
1. Demonstrate career and leadership skills required for employment in the agricultural mechanization industry. DOK3, CRP, CS a. Write and present a speech on a topic related to agricultural mechanization: • Research a topic related to agricultural mechanization. • Write a 2-3 minute speech on the chosen topic. • Present a 2-3 minute speech on the chosen topic. b. Demonstrate skill in advanced parliamentary procedure and public speaking. • Participate in a discussion demonstrating five procedures of parliamentary law. • Lead a minimum of 15 minutes of group discussion. c. Participate in a minimum of 10 hours in a community service activity. d. Build a personal résumé for the purpose of applying for jobs.
2. Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration, such as: DOK4, PST, CRP, CS • Leadership development competitions • Leadership retreats or conferences • Industry related seminars, workshops, or conferences • Arc welding contest • Tractor operations and maintenance contest • Agricultural technology mechanization systems Career Development Event
3. Review individual plans for student SAE programs. DOK2, CRP a. Assess goal attainment in SAE from previous year. b. Review and update short- and long-range goals pertaining to SAE program.
4. Maintain agricultural records for an SAE. DOK3, ABS, CRP a. Redefine and adjust requirements of student, parents, supervisor, and/or employer. b. Utilize an electronic/computer-based system of record keeping. c. Update SAE records to include: • SAE program goals • Student inventory related to SAE program • Expense records • Income/gift and scholarship records • Skill attainment records • Leadership activity records • Community service hours d. Complete degree and proficiency award applications as they apply to SAE. DOK2

Unit 2: Introduction to Agricultural Mechanization

Competencies and Suggested Objectives
1. Investigate the role of mechanical technology in agriculture. DOK1, CS, CRP, PST a. Discuss how mechanization and technology have changed the production of food and fiber. b. Describe the role of emerging technologies in agricultural mechanization: • Computers • Satellite GPS signals • Geographic information systems (GIS) • Unmanned aerial vehicles and remote sensing through satellite imagery • Variable-rate technology • Yield mapping • Auto steering c. Define power and discuss how it is generated and measured. d. Describe sources of power used in agricultural mechanization and associate each course with common applications: • Internal combustion engine • Electric motor • Hydraulic systems • Pneumatic systems
2. Perform basic measurements to applications in agricultural-mechanization technology. DOK1, CRP, CS, PST a. Read a standard and metric ruler or tape measure as it applies to linear measurement. b. Use graduated containers to measure and calculate amounts of standard and metric liquid measurements. c. Use a speed/combination square to measure and mark angles. d. Apply measuring skills to build a student-made project (e.g., toolbox, chicken tractor, dog box)
3. Identify physical science applications in agricultural-mechanization technology. DOK2, CRP, CS, PST a. Name the six simple machines and describe applications in agricultural mechanization for each machine: • Screw • Lever • Pulley • Wedge • Incline plane • Wheel and axle b. Calculate the mechanical advantage of a simple machine, such as a lever, pulley, or wedge.
4. Identify safety precautions and equipment for the work site and school laboratory. DOK2, CRP, CS, PST a. Apply procedures for working in and maintaining a safe and orderly workplace.

b. ~~Describe work site and laboratory organization.~~
c. ~~Demonstrate safe use of head, eye, hearing, body, hand, and foot protective devices.~~
d. ~~Demonstrate rules for hand and power tools, including basic operation, safeguards in place, danger points, observer safety, and electrical safety.~~

Unit 3: Oxyfuel Cutting and Welding and Plasma-Cutting Operations

Competencies and Suggested Objectives
1. Describe and demonstrate principles of oxyfuel, brazing, and cutting procedures. DOK2, CRP, CS, PST a. Describe and apply safety procedures and personal protection equipment for oxyfuel cutting. b. Identify and describe the function of the different parts of the oxyfuel cutting unit: • Cart • Cylinder • Regulators/gauges • Hoses • Torch body • Brazing, cutting, heating, and welding tips c. Set up, ignite, and shut down oxyfuel cutting equipment. d. Describe the characteristics and uses of the different oxyfuel flames (i.e., neutral, oxidizing, and carbonizing). e. Demonstrate how to make a cut in a mild steel plate.
2. Describe and demonstrate principles of plasma-cutting procedures. DOK2, CRP, CS, PST a. Describe and apply safety procedures and personal protection equipment for plasma cutting. b. Identify and describe the function of the different parts of the plasma-cutting unit: • Machine • Compressed air/gas • Electrode • Torch body • Cutting tip • Ground cable and clamp c. Set up, ignite, and shut down plasma-cutting equipment. d. Describe the characteristics and uses of the plasma-cutting machine. e. Demonstrate how to make a cut in a mild steel plate.
3. Apply skills in welding to complete a welding project (e.g., metal gate, grooming stand, small grill). DOK4, CRP, CS, PST

Unit 4: Principles of Metal Fabrication (Arc Welding)

Competencies and Suggested Objectives
1. Describe basic equipment, operations, and procedures, including safety precautions, of arc welding. DOK2, CRP, CS, PST a. Identify and describe the function and use of personal safety equipment and apparel (e.g., clothing, gloves, helmets, safety glasses/goggles). b. Discuss and demonstrate safety precautions to use to prevent electrical shock, eye and skin damage, and respiratory damage while welding. c. List the three major types of arc welders (i.e., SMAW, GMAW [MIG], and GTAW [TIG]) used in agricultural equipment repair and fabrication and discuss their characteristics and applications. d. Describe the purpose/function of tools and accessories used in welding (e.g., electrode holder, ground clamp, cables, electrodes, wire, chipping hammer, and wire brushes). e. Associate common SMAW electrodes and GMAW wire with their weld characteristics and proper use. f. Examine the relationship of amperage, voltage, and electrode type and diameter to electrode and metal type and thickness. g. Discuss common GMAW shielding gases. h. Identify the two types of welds: a fillet weld (F) and a grove weld (G). i. Identify the difference between the two types of weld beads: a stringer bead and a weave bead. j. Identify the five different types of weld joints: • Butt • Lap • T-weld • Corner • Edge k. Compare welding procedures for welding in different welding positions: • 1-Flat • 2-Horizontal • 3-Vertical • 4-Overhead l. Identify weld symbols as they are incorporated into plans and/or drawings (e.g., 1G is a flat grove weld, 2F is a horizontal fillet weld).
2. Perform welding techniques using SMAW and MIG. DOK2, CRP, CS, PST a. Demonstrate the procedure for striking an arc and running a flat bead. b. Construct a flat butt weld. c. Construct a flat fillet weld.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Leadership and Experiential Learning (SAE)		
	1.	Demonstrate career and leadership skills required for employment in the agricultural mechanization industry.
	2.	Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration.
	3.	Review individual plans for student SAE programs.
	4.	Maintain agricultural records for an SAE.
Unit 2: Introduction to Agricultural Mechanization		
	1.	Investigate the role of mechanical technology in agriculture.
	2.	Perform basic measurements to applications in agricultural mechanization technology.
	3.	Identify physical science applications in agricultural mechanization technology.
	4.	Identify safety precautions and equipment for the work site and school laboratory.
Unit 3: Oxyfuel Cutting and Welding and Plasma-Cutting Operations		
	1.	Describe and demonstrate principles of oxyfuel, brazing, and cutting procedures.
	2.	Describe and demonstrate principles of plasma cutting procedures.
	3.	Apply skills in welding to complete a welding project (e.g., metal gate, grooming stand, small grill).
Unit 4: Principles of Metal Fabrication (Arc Welding)		
	1.	Describe basic equipment, operations, and procedures, including safety precautions, of arc welding.
	2.	Perform welding techniques using SMAW and MIG.

Appendix A: Industry Standards

AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

	Unit 1	Unit 2	Unit 3	Unit 4
AFNR				
ABS - AGRIBUSINESS SYSTEMS	X			
CRP - CAREER READY PRACTICES	X	X	X	X
CS - AGRICULTURE, FOOD AND NATURAL RESOURCES CLUSTER SKILL	X	X	X	X
PST - POWER, STRUCTURAL, AND TECHNICAL SYSTEMS	X	X	X	X

ABS – AGRIBUSINESS SYSTEMS
AS – ANIMAL SYSTEMS
BS – BIOTECHNOLOGY
CRP – CAREER READY PRACTICES
CS – AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL
ES – ENVIRONMENTAL SERVICE SYSTEMS
FPP – FOOD PRODUCTS AND PROCESSING SYSTEMS
NRS – NATURAL RESOURCE SYSTEMS
PS – PLANT SYSTEMS
PST – POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

The AFNR Pathway Content Standards and Performance Elements are adapted from *National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards.* Reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314, 800.772.0939. Copyright © 2015 A complete copy of the National Standards can be downloaded from the FFA website at www.ffa.org/thecouncil.

Agribusiness Systems Career Pathway Content Standards

The Agribusiness Systems (ABS) Career Pathway encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), and business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application and management of agribusiness systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of

Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.

- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.

ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.

ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.

ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.

ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.

ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).

ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.

ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.

ABS.04. CCTC Standard: Develop a business plan for an AFNR business.

ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.

ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Common Career Technical Core Career Ready Practices Content Standards

The CCTC CRPs encompass fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical thinking, problem solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency. Students completing a program of study in any AFNR career pathway will demonstrate the knowledge, skills and behaviors that are important to career ready through experiences in a variety of settings (e.g., classroom, CTSO, work-based learning, community etc.).

DEFINITIONS: Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a CTE program of study.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

CRP.02.01. Performance Indicator: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.

CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.

CRP.10.03. Performance Indicator: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

CRP.11.02. Performance Indicator: Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.

CRP.12.01. Performance Indicator: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.

CRP.12.02. Performance Indicator: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

The AFNR Cluster Skills (CS) encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

CS.01. CCTC Standard: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

- **CS.01.01. Performance Indicator:** Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
- **CS.01.02. Performance Indicator:** Examine technologies and analyze their impact on AFNR systems.
- **CS.01.03. Performance Indicator:** Identify public policies and examine their impact on AFNR systems.

CS.02. CCTC Standard: Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.

- **CS.02.01. Performance Indicator:** Research and use geographic and economic data to solve problems in AFNR systems.
- **CS.02.02. Performance Indicator:** Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

- **CS.03.01. Performance Indicator:** Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
- **CS.03.02. Performance Indicator:** Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.

CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.

CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.

CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.

CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

CS.05.01. Performance Indicator: Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).

CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.

CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.

CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Power, Structural and Technical Systems Career Pathway Content Standards

The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

PST.01. CCTC Standard: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

- **PST.01.01. Performance Indicator:** Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.
- **PST.01.02. Performance Indicator:** Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
- **PST.01.03. Performance Indicator:** Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

PST.02. CCTC Standard: Operate and maintain AFNR mechanical equipment and power systems.

- **PST.02.01. Performance Indicator:** Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.
- **PST.02.02. Performance Indicator:** Operate machinery and equipment while observing all safety precautions in AFNR settings.

PST.03. CCTC Standard: Service and repair AFNR mechanical equipment and power systems.

- **PST.03.01. Performance Indicator:** Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.
- **PST.03.02. Performance Indicator:** Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
- **PST.03.03. Performance Indicator:** Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).

PST.04. CCTC Standard: Plan, build and maintain AFNR structures.

- **PST.04.01. Performance Indicator:** Create sketches and plans for AFNR structures.
- **PST.04.02. Performance Indicator:** Determine structural requirements, specifications and estimate costs for AFNR structures
- **PST.04.03. Performance Indicator:** Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

- **PST.04.04. Performance Indicator:** Apply electrical wiring principles in AFNR structures.

PST.05. CCTC Standard: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.

- **PST.05.01. Performance Indicator:** Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.
- **PST.05.02. Performance Indicator:** Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.

~~**PST.05.03. Performance Indicator:** Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.~~

Appendix B: 21st Century Skills[1]

21st Century Crosswalk for Science of Agricultural Mechanization Level I											
	Units	Unit 1	Unit 2	Unit 3	Unit 4						
21st Century Standards											
CS1		X									
CS2		X									
CS3		X									
CS5		X									
CS6		X	X	X	X						
CS7		X	X	X	X						
CS8		X	X	X	X						
CS9		X	X	X	X						
CS10			X								
CS11		X	X	X	X						
CS12		X	X	X	X						
CS13		X	X	X	X						
CS14		X	X	X	X						
CS15		X	X	X	X						
CS16		X	X	X	X						

CSS1 21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals

[1] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action toward addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2-Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3-Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4-Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

~~**CS14 Social and Cross-Cultural Skills**~~

~~1. Interact Effectively with others~~

~~2. Work Effectively in Diverse Teams~~

~~**CS15 Productivity and Accountability**~~

~~1. Manage Projects~~

~~2. Produce Results~~

~~**CS16 Leadership and Responsibility**~~

~~1. Guide and Lead Others~~

~~2. Be Responsible to Others~~

Appendix C: College and Career Ready Standards

English Standards											
	Units	Unit 1	Unit 2	Unit 3	Unit 4						
W.9.1		X									
W.9.2		X									
W.9.3		X									
W.9.4		X									
W.9.5		X									
W.9.6		X									
W.9.7		X									
W.9.8		X									
W.9.9		X									
W.9.10		X									
SL.9.1		X	X	X	X						
SL.9.2		X	X	X	X						
SL.9.3		X	X	X	X						
SL.9.4		X	X	X	X						
SL.9.5		X	X	X	X						
SL.9.6		X	X	X	X						
L.9.1		X									
L.9.2		X									
L.9.3		X									
L.9.4		X									
L.9.5		X									
L.9.6		X									
RST.9-10.1		X	X	X	X						
RST.9-10.2		X	X	X	X						
RST.9-10.3		X	X	X	X						
RST.9-10.4		X	X	X	X						
RST.9-10.5		X	X	X	X						
RST.9-10.6		X	X	X	X						
RST.9-10.7		X	X	X	X						
RST.9-10.8		X	X	X	X						
RST.9-10.9		X	X	X	X						
RST.9-10.10		X	X	X	X						
WHST.9-10.1		X									
WHST.9-10.2		X									
WHST.9-10.3		X									
WHST.9-10.4		X									
WHST.9-10.5		X									
WHST.9-10.6		X									
WHST.9-10.7		X									
WHST.9-10.8		X									
WHST.9-10.9		X									
WHST.9-10.10		X									
W.11.1		X									
W.11.2		X									
W.11.3		X									
W.11.4		X									
W.11.5		X									
W.11.6		X									
W.11.7		X									
W.11.8		X									
W.11.9		X									
W.11.10		X									
SL.11.1		X	X	X	X						
SL.11.2		X	X	X	X						

SL.11-3		X	X	X	X						
SL.11-4		X	X	X	X						
SL.11-5		X	X	X	X						
SL.11-6		X	X	X	X						
RST.11-12.1		X									
RST.11-12.2		X									
RST.11-12.3		X									
RST.11-12.4		X									
RST.11-12.5		X									
RST.11-12.6		X									
RST.11-12.7		X									
RST.11-12.8		X									
RST.11-12.9		X									
RST.11-12.10		X									
WHST.11-12.1		X									
WHST.11-12.2		X									
WHST.11-12.6		X									
WHST.11-12.8		X									

College and Career Ready English I

College and Career Ready English I
Writing Text Types and Purposes

W.9.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
W.9.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
W.9.1b Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
W.9.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
W.9.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
W.9.1e Provide a concluding statement or section that follows from and supports the argument presented.
W.9.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
W.9.2a Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
W.9.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
W.9.2c Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

College and Career Ready English I

W.9.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic.
W.9.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
W.9.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
W.9.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
W.9.3a Engage and orient the reader by setting out a problem, situation, or observation, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

W.9.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.
W.9.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole.
W.9.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
W.9.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.9.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
W.9.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10.)
W.9.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

W.9.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

College and Career Ready English I

W.9.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
W.9.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
W.9.9a Apply grades 9–10 Reading standards to literature (e.g., "Analyze how an author draws on and transforms source material in a specific work [e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare]").
W.9.9b Apply grades 9–10 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning").

Range of Writing

W.9.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audience.

College and Career Ready English I

SL.9.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
SL.9.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
SL.9.1b Work with peers to set rules for collegial discussions and decision making (e.g., informal consensus, taking votes on key issues, and presentation of alternate views), clear goals and deadlines, and individual roles as needed.
SL.9.1c Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

SL.9.1d Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
SL.9.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
SL.9.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.

Presentation of Knowledge and Ideas

SL.9.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

College and Career Ready English I

SL.9.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
SL.9.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 for specific expectations.)

College and Career Ready English I
Language
Conventions of Standard English

L.9.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
L.9.1a Use parallel structure.*
L.9.1b Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
L.9.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
L.9.2a Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
L.9.2b Use a colon to introduce a list or quotation.
L.9.2c Spell correctly

Knowledge of Language

L.9.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening
L.9.3a Write and edit work so that it conforms to the guidelines in a style manual (e.g., MLA Handbook, Turabian's Manual for Writers) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

L.9.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.
L.9.4a Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L.9.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy).

College and Career Ready English I

L.9.4c Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.
L.9.4d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).

L.9.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
L.9.5a Interpret figures of speech (e.g., euphemism, oxymoron) in context and analyze their role in the text.
L.9.5b Analyze nuances in the meaning of words with similar denotations.
L.9.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

College and Career Ready English II

Grades 9-10: Literacy in Science and Technical Subjects
Reading in Science and Technical Subjects Key Ideas and Details
RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure
RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts

Range of Reading and Level of Text Complexity
RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Writing in History/SS, Science, and Technical Subjects
Writing Text Types and Purposes
WHST.9-10.1 Write arguments focused on discipline-specific content.
WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.
WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

Grades 9-10
Writing in History/SS, Science, and Technical Subjects

WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
WHST.9-10.3 Not Applicable

Production and Distribution of Writing

WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

Grades 9-10
Writing in History/SS, Science, and Technical Subjects
Range of Writing

WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

English III

English III

Writing

W.11.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

W.11.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.

W.11.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.

W.11.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

W.11.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11.1e Provide a concluding statement or section that follows from and supports the argument presented.

W.11.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

W.11.2a Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

English III

W.11.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

W.11.2c Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

W.11.2d Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.

W.11.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.11.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

W.11.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

W.11.3a Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

W.11.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.

W.11.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).

W.11.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.

W.11.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.11.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

English III

W.11.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12.)
W.11.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

W.11.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
W.11.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
W.11.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
W.11.9a Apply grades 11–12 Reading standards to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics").
W.11.9b Apply grades 11–12 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., The Federalist, presidential addresses]").

Range of Writing

W.11.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

English III
Speaking and Listening
Comprehension and Collaboration

SL.11.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
SL11.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
SL.11.1b Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.
SL.11.1c Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
SL.11.1d Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
SL.11.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
SL.11.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

Presentation of Knowledge and Ideas

SL.11.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

English III

SL11.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
SL.11.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See grades 11–12 Language standards 1 and 3 for specific expectations.)

English III

Grades 11-12: Literacy in Science and Technical Subjects
Reading in Science and Technical Subjects Key Ideas and Details

RST. 11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

RST.11-12.10 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Grades 11-12: Writing I History/SS, Science and Technical Subjects
Writing
Text Types and Purposes

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

~~Grades 11-12: Writing I History/SS, Science and Technical Subjects~~

~~WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.~~

~~Production and Distribution of Writing~~

~~WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.~~

~~WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.~~

Appendix D: College and Career Ready Standards

Mathematics Standards											
	Units	Unit 1	Unit 2	Unit 3	Unit 4						
N-Q.1		X	X	X	X						
N-Q.2		X	X	X	X						
N-Q.3		X	X	X	X						
8.G.6			X	X	X						
8.G.7			X	X	X						
8.G.8			X	X	X						
G-CO.1			X	X	X						
G-CO.2			X	X	X						
G-CO.3			X	X	X						
G-CO.4			X	X	X						
G-CO.5			X	X	X						
G-CO.6			X	X	X						
G-CO.7			X	X	X						
G-CO.8			X	X	X						
G-CO.9			X	X	X						
G-CO.10			X	X	X						
G-CO.11			X	X	X						
G-CO.12			X	X	X						
G-CO.13			X	X	X						
G-GPE.5			X	X	X						
G-GPE.6			X	X	X						
G-GPE.7			X	X	X						
G-GMD.1			X	X	X						
G-GMD.3			X	X	X						
G-GMD.4			X	X	X						
G-MG.1			X	X	X						
G-MG.2			X	X	X						
G-MG.3			X	X	X						

Number and Quantity

Reason quantitatively and use unites to solve problems

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

Geometry

Understand and apply the Pythagorean Theorem

8.G.6 Explain a proof of the Pythagorean Theorem and its converse.

8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Experiment with transformations in the plane

G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G-CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs.

Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Understand congruence in terms of rigid motions

G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

G-CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

G-CO.9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.

G-CO.10 Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

G-CO.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Geometry Course

Make geometric constructions

G-CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Use coordinates to prove simple geometric theorems algebraically

G-GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

G-GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

Explain volume formulas and use them to solve problems

G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.

G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

~~Visualize relationships between two-dimensional and three-dimensional objects~~

~~G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.~~

~~Apply geometric concepts in modeling situations~~

~~G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*~~

~~G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*~~

~~G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*~~

~~Visualize relationships between two-dimensional and three-dimensional objects~~

~~G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.~~

Appendix E: International Society for Technology in Education Standards (ISTE)

	Course	Unit 1	Unit 2	Unit 3	Unit 4						
ISTE Standards											
T1		X	X	X	X						
T2		X	X	X	X						
T3		X	X	X	X						
T4		X	X	X	X						
T5		X	X	X	X						
T6		X	X	X	X						

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.
b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.

2017 AEST Science of Agricultural Mechanization Level II

Program CIP: 01.0201 Agricultural Mechanization, General

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The Research and Curriculum Unit (RCU), located in Starkville, MS, as part of Mississippi State University, was established to foster educational enhancements and innovations. In keeping with the land grant mission of Mississippi State University, the RCU is dedicated to improving the quality of life for Mississippians. The RCU enhances intellectual and professional development of Mississippi students and educators while applying knowledge and educational research to the lives of the people of the state. The RCU works within the contexts of curriculum development and revision, research, assessment, professional development, and industrial training.

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Standards

Standards are superscripted in each unit and are referenced in the appendices. Standards in the AEST Science of Agricultural Mechanization Curriculum Framework and Supporting Materials are based on the following:

National Agriculture, Food and Natural Resources (AFNR) Career Cluster Content Standards

The National Council for Agricultural Education (The Council) shapes and strengthens school-based agricultural education at all levels. The Council and the National AFNR Career Cluster Content Standards Committee have developed the career pathway content standards to outline technical knowledge and skills required for future success within Agriculture and Environmental Science and Technology. The content standards are intended to provide a forward-thinking guide for what students should know and be able to do after completing this program of study. The standards referenced in this curriculum are reprinted with permission from the National Council for Agricultural Education, 1410 King Street, Suite 400, Alexandria, VA 22314. (800) 772-0939. Copyright © 2015. https://www.ffa.org/thecouncil/afnr.

College and Career-Ready Standards

The College and Career-Ready Standards emphasize critical thinking, teamwork and problem-solving skills. Students will learn the skills and abilities demanded by the workforce of today and the future. Mississippi adopted Mississippi College- and Career-Ready Standards (MCCRS) because they provide a consistent, clear understanding of what students are expected to learn so that teachers and parents know what they need to do to help them. Reprinted from http://www.mde.k12.ms.us/MCCRS

International Society for Technology in Education Standards (ISTE)

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21st Century Skills and Information and Communication Technologies Literacy Standards

In defining 21st-century learning, the Partnership for 21st Century Skills has embraced five content and skill areas that represent the essential knowledge for the 21st century: global awareness; civic engagement; financial, economic, and business literacy; learning skills that encompass problem-solving, critical-thinking, and self-directional skills; and information and communication technology (ICT) literacy.

Preface

Secondary career and technical education programs in Mississippi face many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, *Mississippi Code of 1972*, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, Ch. 487, §14; Laws, 1991, Ch. 423, §1; Laws, 1992, Ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act IV, 2007; and Every Student Succeeds Act 2015.).

Mississippi Teacher Professional Resources

The following are resources for Mississippi teachers.

Curriculum, Assessment, Professional Learning, and other program resources can be found at The Research and Curriculum Unit's website: http://www.rcu.msstate.edu

Should you need additional instructions regarding these resources, please call 662.325.2510.

The National FFA Organization website has educator resources, student organization guidelines and program information, professional organization information and experiential learning guidelines. All Agricultural Education teachers have been given free access to these resources at www.ffa.org.

Executive Summary

Pathway Description

AEST science of agricultural mechanization is one of the five pathway courses in the agricultural and environmental science and technology (AEST) program. All students must complete the Concepts of Agriscience and Science of Agricultural Mechanization Level I courses before being allowed to enroll in the Science of Agricultural Mechanization Level II course. This course within the agricultural mechanization pathway teaches advanced skills in mechanization as they apply to various aspects of an agricultural work environment. Students will attain advanced knowledge and skills in areas such as electricity, welding and fabrication, hydraulics and pneumatics, and the management and operation of agricultural equipment. Emphasis is on an active learning environment enriched with technology, engineering, and math-based applications. The course carries one Carnegie Unit of credit that can count toward high school graduation.

Industry Certification

No national industry-recognized certifications are known to exist at this time in the field of agriscience. Competencies and suggested performance indicators in the science of agricultural mechanization course have been correlated, however, to the National Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards that have been reviewed and endorsed at the national level by the National Council on Agricultural Education.

Assessment

The latest assessment blueprint for the curriculum can be found at http://www.rcu.msstate.edu/Curriculum/CurriculumDownload.aspx.

Student Prerequisites

In order for students to experience success in the program, the following student prerequisites are suggested:

1. Concepts of Agriscience – successful completion of course and MS-CPAS2 assessment
2. Science of Agricultural Mechanization Level I – successful completion of course

Applied Academic Credit

The latest academic credit information can be found at http://www.mde.k12.ms.us/ACCRED/AAS.
Once there, click the "Mississippi Public School Accountability Standards Year" tab.
Review the appendices for graduation options and superscript information regarding specific programs receiving academic credit.
Check this site often as it is updated frequently.

Teacher Licensure

The latest teacher licensure information can be found at http://www.mde.k12.ms.us/educator-licensure.

~~**Professional Learning**~~

~~If you have specific questions about the content of any of training sessions provided, please contact the Research and Curriculum Unit at 662.325.2510.~~

~~.~~

Course Outlines

Course Description: The Science of Agricultural Mechanization Level II course teaches advanced skills in mechanization as they apply to various aspects of an agricultural work environment. Students will attain advanced knowledge and skills in areas such as electricity, welding and fabrication, hydraulics and pneumatics, and the management and operation of agricultural equipment. Emphasis is on an active learning environment enriched with technology, engineering, and math-based applications. The course is the advanced level for the science of agricultural mechanization pathway within the AEST program. The focus is to begin the preparation of students for further study leading to successful careers in the agricultural industry.

Science of Agricultural Mechanization Level II (One Carnegie Unit) – Course Code: 991022

Unit	Unit Name	Hours
1	Leadership and Experiential Learning (SAE)	5
2	Safety Applications in Agricultural Mechanization	5
3	Hydraulic and Pneumatic Systems in Agriculture	10
4	Electrical Systems Applications in Agriculture	10
5	Management and Operation of Agricultural Equipment	25
6	Principles of Internal Combustion Gas Engines	20
7	Principles of Internal Combustion Diesel Engines	20
8	Application of Metal Fabrication in Agriculture	25
9	Application of Agricultural Technology Mechanical Systems	20
Total		140

Research Synopsis

Introduction

The agricultural sciences career cluster covers the broad field of occupations related to the production and use of plants and animals for food, fiber, aesthetic, and environmental purposes. According to the U.S. Department of Agriculture, during the next five years (2015-2020) 57,900 jobs are expected to open in food, agriculture, renewable natural resources, or the environment for graduates with bachelor's or higher degrees in those areas. Almost half of those jobs will be in management and business; 27% in science, technology, engineering, and math in agriculture; 15% in sustainable food and biomaterials production; and 12% in education, communication, and government services. According to U.S. Department of Agriculture statistics, $167.3 billion was earned in agriculture, forestry, fishing, and hunting in the United States in 2014. The Mississippi Department of Agriculture and Commerce reports that agriculture is a $7.9 billion industry, employing approximately 29% of the state's workforce.

AEST courses target careers at the professional and technical levels in agriculture. Students enrolled in these courses should be better prepared to pursue degrees at the community college and four-year college levels.

Needs of the Future Workforce

Data for this synopsis were compiled from the Mississippi Department of Employment Security (2015). Employment opportunities for each of the occupations are listed below:

Table 1.1: Current and Projected Occupation Report

Occupation	Employment		Projected Growth 2010-2020		Average Wage 2015	
	Current (2010)	Projected (2020)	Number	Percent	Hourly	Annual
Agricultural and Food Science Technicians	190	200	10	5.3	$15.92	$33,120
Agricultural Equipment Operators	280	300	20	7.1	$17.32	$36,020
Conservation Scientists	1,270	1,330	60	4.7	$26.05	$54,190
Environmental Engineers	890	950	60	6.7	$34.70	$72,170
Environmental Engineering Technicians	100	110	10	10.0	$20.44	$42,510
Environmental Scientists and Specialists, Including Health	920	990	70	7.6	$27.02	$56,190
Environmental Science and Protection Technicians, Including Health	30	40	10	33.3	$19.73	$41,030
Soil and Plant Scientists	70	80	10	14.3	$39.74	$82,660

Farmworkers and Laborers, Crop, Nursery, and Greenhouse	690	690	0	0.0	$9.39	$19,540
Farmworkers, Farm and Ranch Animals	440	460	20	7.1	$10.17	$21,150
First-Line Supervisors/Managers of Farming, Fishing, and Forestry Workers	300	310	10	3.3	$22.61	$47,030
Foresters	650	670	20	3.1	$52,660	$17.73
Forest and Conservation Workers	70	80	10	14.3	$20.26	$42,150
Veterinarians	430	520	90	20.9	$39.15	$81,440
Veterinary Assistants and Laboratory Animal Caretakers	580	580	0	0.0	$10.30	$21,430
Veterinary Technologists and Technicians	610	800	190	31.1	$15.13	$31,470

Source: Mississippi Department of Employment Security, www.mdes.ms.gov.

Perkins IV Requirements

Curriculum Content

In compiling the research for the agricultural sciences cluster, face-to-face and telephone interviews were conducted with representatives of agricultural employers and agencies. The following comments summarize the results of these interviews:

Summary of Standards

- While opportunities to enter farming on a full-scale commercial enterprise basis are limited, opportunities do exist and are expected to increase as current operators retire and begin to rent their land to companies and individuals. Opportunities are also expected to increase for consultants and technicians who support production enterprises by providing specialized services to producers.
- There was general agreement among all persons interviewed that students need to better develop skills related to leadership; teamwork; communication; and work ethic, habits, and values. All respondents also indicated that a basic knowledge of economics, record keeping, budgeting, and business decision-making skills will be essential in today's "lean" environment.
- Opportunities for high school graduates in all fields of agriculture are limited to the basic entry-level positions. More abundant opportunities exist for students who have received advanced training at the community college or university level.
- All respondents agreed that a College and Career Ready foundation of knowledge and skills existed across all major pathways related to the following themes: leadership and personal development; principles of plant science and production; principles of soil science and air and water quality; principles of agricultural power, structures, and technology; and principles

of economics and management. A sixth theme, principles of animal science and production, exists for students in the AEST and agriculture and natural resources pathway.

- All respondents agreed that students in all pathways should be exposed to the process by which agricultural products are grown, managed, harvested, processed, and marketed. As students study this process, they should also be exposed to the different careers that are involved in all segments of the industry.
- The role of federal and state agencies, including the USDA, OSHA, FDA, and EPA, should be discussed. Also, the role of agricultural organizations, such as the Poultry Association, Nurseryman's Association, and Farm Bureau, needs to be investigated.

Academic Infusion

The AEST curriculum is tied to the Mississippi College- and Career-Ready Standards. The curriculum provides multiple opportunities to enhance and reinforce these academic skills. Because students will be required to communicate effectively in the classroom as well as in the workforce, there is a considerable amount of reading and writing in this curriculum. Overall, the AEST curriculum requires students to make presentations, read technical manuals, and use strategic and critical-thinking skills to solve real-world problems. The location of the College- and Career-Ready Standards for each unit is located in Appendix E.

Transition to Postsecondary Education

The latest articulation information for secondary to postsecondary can be found at the Mississippi Community College Board website: http://www.mccb.edu/.

Best Practices

The premise of the success of all school-based, agricultural-education programs is focused on the implementation of the three-circle model, which depicts the three major components of the program interlocked and working together as one. The three components are classroom and laboratory instruction, experiential learning through supervised agricultural experience (SAE) programs for individual students, and participation in the CTE student organization for agriculture education, the National FFA organization.

Classroom and Laboratory Instruction

The classroom and laboratory component of the school-based, agricultural-education, three-circle model is the foundation of the success of the other two components. Through contextual learning, students in agricultural education can learn the science, business, and technology of modern agriculture through innovative instructional technologies, differentiated instruction, and cooperative learning.

Innovative Instructional Technologies

Recognizing that today's students are digital learners, the classroom should be equipped with tools that will teach them in the way they need to learn. The AEST teacher's goal should be to include teaching strategies that incorporate current technology. It is suggested that each classroom house a classroom set of smart tablets and one teacher laptop. To make use of the latest online communication tools, such as wikis, blogs, and podcasts, the teacher is encouraged to use a learning-management system that introduces students to teaching and learning strategies in an online environment and places the responsibility of learning on the student.

Differentiated Instruction

All students are unique and possess an individualized learning style. Differentiated instruction is an approach to teaching that addresses the differences in learning styles by providing alternative teaching and assessment methods that reach across the spectrum of student needs in the classroom. By differentiating instruction in AEST, teachers can more effectively reach students and address their strengths and weaknesses, therefore increasing student success. The implementation of various forms of technology; use of alternative assessments, such as rubrics and problem-based assessment; and utilizing hands-on and work-based learning opportunities in the program of instruction truly enhance the quality of the curriculum presentation.

Cooperative Learning

Cooperative learning can help students understand topics when independent learning cannot. Therefore, you will see several opportunities in the science of agricultural mechanization curriculum for group work. To function in today's workforce, students need to be able to work collaboratively with others and solve problems without excessive conflict. The science of agricultural mechanization curriculum provides opportunities for students to work together and help each other complete complex tasks.

Experiential Learning (SAE)

The experiential learning (SAE) component has long been an integral part of the school-based, agricultural-education, three-component model. Each student is encouraged to explore their career interests and plan an experiential, service, and/or work-based learning program to guide them to their career goals. This SAE program guides the student as they maintain a record-keeping system of the time and money invested, as well as the skills gained from their experiences. The experiential learning projects can be used in a variety of situations to reinforce and complement classroom theory and content. The experiential learning project consists of entrepreneurship, placement, research/experimentation, and exploratory discovery and spans the duration of program enrollment.

CTE Student Organizations

As the third part of the school-based, agricultural-education program, the FFA component is the showcase, or focal point, of leadership, growth, and development for students. The FFA is the student organization for the science of agricultural mechanization curriculum. The FFA offers many opportunities for student success, such as leadership development, career development events, degrees of attainment, awards and scholarships, and community service. The FFA provides students with growth opportunities and competitive events. It also opens the doors to the world of agriculture and scholarship opportunities.

Conclusion

The AEST curriculum is one of Mississippi's most comprehensive agriculture curricula. It is a systematic program of instruction, and students who complete this program are well equipped for a variety of careers and the ability to make informed choices regarding food, fiber, and managing natural resources. Instructors are urged to encourage AEST science of agricultural mechanization curriculum students to pursue postsecondary educational opportunities at community colleges and universities in Mississippi.

Professional Organizations

Agricultural Education Division of the Association for Career and Technical Education. May be found online at http://www.acteonline.org/

American Association for Agricultural Education. May be found online at http://aaaeonline.org/

Mississippi ACTE. May be found online at http://www.mississippiacte.com/

Mississippi Association of Vocational Agriculture Teachers (MAVAT). May be found online at www.mississippiffa.org

National Association of Agricultural Educators. May be found online at http://www.naae.org/

National Association of Supervisors of Agricultural Education. May be found online at https://www.ffa.org/thecouncil/nasae/

National FFA Alumni Association. May be found online at https://www.ffa.org/getinvolved/alumni/

National FFA Foundation, Inc. May be found online at https://www.ffa.org/support/foundation/

National Farm and Ranch Business Management Education Association. May be found online at http://www.nfrbmea.org/

National Postsecondary Agricultural Student Organization. May be found online at http://www.nationalpas.org/

National Young Farmer Educational Association. May be found online at http://www.nyfea.org

Using This Document

Suggested Time on Task

This section indicates an estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75–80% of the time in the course.

Competencies and Suggested Objectives

A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies. The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.

Integrated Academic Topics, 21st Century Skills and Information and Communication Technology Literacy Standards, ACT College Readiness Standards, and Technology Standards for Students

This section identifies related academic topics as required in the Subject Area Testing Program (SATP) in Algebra I, Biology I, English II, and U.S. History from 1877, which are integrated into the content of the unit. Research-based teaching strategies also incorporate ACT College Readiness standards. This section also identifies the 21st Century Skills and Information and Communication Technology Literacy skills. In addition, national technology standards for students associated with the competencies and suggested objectives for the unit are also identified.

Unit 1: Leadership and Experiential Learning (SAE)

Competencies and Suggested Objectives
1. Assess personal career and leadership skills required for employment in the agricultural-mechanization industry. DOK3, CRP, CS a. Self-evaluate workplace soft skills and discuss how they apply to real work situations: • Complete a personality or strengths assessment. • Discuss workplace ethics. • Investigate time-management techniques. b. Participate in five leadership activities through the FFA above the local level. c. Investigate involvement opportunities in Farm Bureau, Young Farmers and Ranchers, or other agricultural-related organizations. d. Participate in a minimum of 25 hours of community service in at least two different activities. e. Identify potential college and career opportunities in animal agriculture: • Research colleges and universities that offer studies in agricultural mechanization or a related field. • Complete an application for college admission and scholarships. • Revise a personal résumé for the purpose of applying for a specific job. • Complete a job application for employment. • Participate in a mock or real interview.
2. Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration, such as: DOK4, PST, CRP, CS • Leadership-development competitions • Leadership retreats or conferences • Industry-related seminars, workshops, or conferences • Tractor operations and maintenance contest • Arc welding contest • Agricultural-mechanization technology systems Career Development Event
3. Review individual plans for student SAE programs. DOK2, CRP a. Assess goal attainment in SAE from previous year. b. Review and update short- and long-range goals pertaining to SAE program.
4. Maintain agricultural records for an SAE. DOK2, ABS, CRP a. Redefine and adjust requirements of student, parents, supervisor, and/or employer. b. Utilize an electronic/computer-based system of record keeping. c. Update SAE records to include: • SAE program goals • Student inventory related to SAE program • Expense records • Income/gift and scholarship records

- ~~Skill-attainment records~~
- ~~Leadership-activity records~~
- ~~Community service hours~~

d. ~~Complete degree and proficiency award applications as they apply to SAE.~~

Unit 2: Safety Applications in Agricultural Mechanization

Competencies and Suggested Objectives
1. Conduct agricultural workplace safety inspections to OSHA standards. DOK2, CRP, CS, PST a. Discuss the risks associated with working in the agricultural industry. b. List OSHA guidelines related to work settings in agriculture.
2. Demonstrate safety procedures associated with equipment and tools in the agricultural mechanization workplace. DOK2, CRP, CS, PST a. Apply procedures for working in and maintaining a safe and orderly workplace. b. Describe work site and laboratory organization. c. Demonstrate safe use of head, eye, hearing, body, hand, and foot protective devices. d. Demonstrate rules for hand and power tools, including basic operation, safeguards in place, danger points, observer safety, and electrical safety. e. Demonstrate safety rules and guidelines related to the operation and maintenance of agricultural equipment, including power machinery and implements.

Unit 3: Hydraulic and Pneumatic Systems in Agriculture

Competencies and Suggested Objectives

1. Explore principles of hydraulics and pneumatics. DOK4, CRP, CS, PST
   a. Identify major components and their purpose and function of hydraulic and pneumatic systems:
      - Reservoir
      - Pump
      - Control valves
      - Check valves
      - Filter
      - Lines
      - Cylinders (single and double action)
      - Compressors (single spring and double spring action)
      - Lever
      - Pressure gauges
   b. Calculate and measure PSI.
   c. Describe and apply Pascal's law and Boyle's law.
   d. Apply the relationship of area and force to pressure in a hydraulic system and pneumatic system.
   e. Create a flowchart and schematic utilizing the major components of a hydraulic system and pneumatic system.
   f. Compare and contrast the operation of a pneumatic system to the operation of a hydraulic system.
   g. Demonstrate the operation of a pneumatic system to perform work.
   h. Demonstrate the operation of a hydraulic system to perform work.
   i. Perform maintenance on both hydraulic and pneumatic systems.
   j. Troubleshoot hydraulic and pneumatic systems on agricultural equipment.
   k. Construct a simple hydraulic and or pneumatic system using hydraulic trainer, if available.

Unit 4: Electrical Systems Applications in Agriculture

Competencies and Suggested Objectives

1. Describe and apply the use of electrical components and systems in agricultural equipment. DOK3, CRP, CS, PST

   a. Identify common symbols, schematics, and drawings of electrical systems:
      - Fuse
      - Circuit breaker
      - Battery
      - Relay
      - Ammeter
      - Resistor
      - Push-button switch
      - Single-receptacle outlet
      - Single-pole switch
      - Double-pole switch
      - Three-way switch
      - Ground connection
      - Wire identification, type, and size codes
      - Schematic for a branch circuit

   b. Measure resistance, voltage, and current in circuits using multimeter.

   c. Calculate resistance, voltage, and current in circuits using Ohm's law.

   d. Compare the functions of basic electrical devices:
      - Conductors
      - Switches
      - Service entrance panel
      - Breaker
      - Receptacle
      - Light

   e. Construct, operate, and test electrical circuits (parallel and series) for:
      - Current
      - Voltage
      - Resistance (Ohms)

2. Explore the functions of basic electric and electronic devices (e.g., conductors, switches, diodes, rheostats, resistors, semiconductors, and potentiometers.) DOK1, PST

3. Demonstrate how an electrical system is used in various types of agricultural equipment: DOK2, CRP, CS,

   - Electric motor

• Electrical connections on machinery and equipment (e.g., battery, lights)
4. Calculate and measure electrical power: DOK3, CRP, CS, PST • Amps • Volts • Watts
5. Apply electrical wiring and trouble-shooting skills to successfully wire an operational agricultural project. DOK4, CRP, CS, PST

Unit 5: Management and Operation of Agricultural Equipment

Competencies and Suggested Objectives
1. Describe the importance of machinery management and maintenance. DOK1, CRP, CS, PST
2. Demonstrate the proper safety practices and operational skills for mechanized agricultural equipment. DOK2, CRP, CS, PST a. Identify common equipment controls and describe their use and function: • Throttle • Clutch • Brakes • Hydraulic valves • Transmission shift controls b. Demonstrate procedures for preinspection and start-up of an internal combustion engine: • Check oil level. • Check fuel level. • Check fuel shut-off valve. • Check for obstructions. • Check coolant fluid level if liquid cooled, fins if air cooled. c. Locate and interpret operation procedures in the owner's manual. d. Operate (any locally available) equipment in a safe and proper manner, which includes driving, backing two-wheeled equipment, and properly hitching to selected equipment. e. Pre-inspection: • Check tire inflation • Check brakes • Check clutch • Adjust seat and seat belt • Adjust steering • Check throttle ○ Operation inspection • Oil pressure • Ammeter • Temperature • Fuel level ○ Operation • Wear seat belt • Clutch engagement • Clean gear shifting • Avoid stalling the engine

- Avoid excessive engine speed
- Avoid excessive speed
- Avoid unsafe conduct during operation

3. Demonstrate recommended maintenance practices for agricultural equipment. DOK3, CRP, CS, PST

a. Discuss the meaning of "preventive maintenance."
b. List and describe the safety precautions to follow while performing preventive maintenance:
   - Eye protection
   - PPE
   - Fire extinguisher
   - Proper tool use
c. Locate and interpret preventative maintenance information in the owner's manual.
d. Perform the following maintenance routines:
   - Inspect and service an air cleaner.
   - Inspect and service the lubrication system.
   - Inspect and service the fuel system.
   - Inspect and service belts and hoses.
   - Inspect and service a liquid-coolant system.
e. Complete a work order for a given repair or maintenance procedure and calculate cost of the repair.

4. Develop diagnostic skills and demonstrate approved repair procedures for agricultural equipment. DOK3, CRP, CS, PST

a. Identify faults on agricultural equipment.
b. Demonstrate correct repair procedures.
c. Complete a work order.
d. Prove repairs are complete by successfully starting/operating the equipment.

Unit 6: Principles of Internal Combustion Gas Engines

Competencies and Suggested Objectives
1. Describe the functions and operation of major systems of a small gasoline engine. DOK2, CRP, CS, PST a. Discuss and apply safety principles while working on engines. b. Describe the basic principle of combustion and force as it is applied to an internal combustion engine. c. Compare and contrast the operating principles of four-stroke and two-stroke gasoline engines. d. Compare and contrast the operating principles of gasoline and diesel engines. e. Describe the types of the lubrication system: • Splash • Pressurized (plunger and rotary) f. Select proper lubricants and fuels based on the manufacturer's recommendation. g. Describe the types of air- and liquid-cooled engine cooling systems: • Air-cooling fins • Liquid cooling o Water pump o Radiator cap o Radiator o Thermostat h. Describe the parts and function of a small gasoline-engine fuel system: • Carburetor • Tank • Pump/gravity flow • Filter i. Describe the parts and functions of a small gasoline-engine ignition system: • Spark plug • Ignition coil • Switch • Power source (battery-pull rope)
2. Disassemble, inspect, and reassemble a small gasoline engine. DOK3, CRP, CS, PST a. Disassemble a small gasoline engine, including removing the head, oil pan, piston and crankshaft assembly, and valves. b. Inspect and measure parts of the engine to verify it is within tolerances set by the manufacturer. c. Reassemble the engine and test for proper operation (e.g., compression, ignition).

Unit 7: Principles of Internal Combustion Diesel Engines

Competencies and Suggested Objectives
1. Investigate the functions and operation of major systems of a diesel engine. DOK2, CRP, CS, PST a. Discuss and apply safety principles while working on engines. b. Describe the basic principle of combustion and force as it is applied to an internal combustion diesel engine. c. Calculate how horsepower is measured in a diesel engine. d. Calculate and measure torque (foot/lbs.) in a diesel engine.
2. Disassemble, inspect, and reassemble a diesel engine. DOK3, CRP, CS, PST a. Disassemble a small diesel engine, including removing the head, oil pan, piston and crankshaft assembly, and valves. b. Inspect and measure parts of the engine to verify it is within tolerances set by the manufacturer. c. Reassemble the engine and test for proper operation (e.g., compression, ignition).

Unit 8: Application of Metal Fabrication in Agriculture

Competencies and Suggested Objectives
1. Review welding techniques and perform welding techniques using shielded metal arc welding (SMAW- "stick"). DOK3, CRP, CS, PST a. Demonstrate the procedure for striking an arc and running a vertical up and horizontal up-butt weld. b. Demonstrate the procedure for striking an arc and running a vertical up and horizontal up-fillet weld.
2. Review and perform welding techniques using gas metal arc welding (GMAW [MIG]). DOK3, CRP, CS, PST a. Review and demonstrate the procedure for striking an arc and running a vertical up-butt weld. b. Demonstrate the procedure for striking an arc and running a vertical up-fillet weld.
3. Perform welding brazing techniques. DOK3, CRP, CS, PST a. Demonstrate the proper procedure for turning on an oxyacetylene rig. b. Demonstrate the proper procedure for using a brazing rod to fuse metal. c. Demonstrate the proper procedure for shutting down an oxyacetylene rig.
4. Observe methods of metal fabrication using a programmable plasma cutter/computer numerical control (CNC) machine. DOK3, CRP, CS, PST
5. Apply skills learned in metal fabrication on a welding fabrication project. DOK4, CRP, CS, PST

Unit 9: Application of Agricultural Technology Mechanical Systems

Competencies and Suggested Objectives
1. Apply skills learned to repair an agricultural mechanics project for a specified purpose. DOK4, CRP, CS, PST a. List types of repair projects and their purposes: • Livestock show equipment • Wood projects (e.g., furniture, cages) • Farm implements • Metal works b. Read and interpret blueprints for a specific agricultural mechanics project. c. Using project blueprints, develop a bill of materials to repair an agricultural mechanics project. d. Estimate costs associated with a project repair plan.
2. Design and/or build an agricultural mechanics project. DOK4, CRP, CS, PST a. Select a project to build b. Draw or interpret plans and/or sketches of the project. c. Create a bill of materials needed to construct the project. d. Calculate the cost of building the project. e. Procure supplies and materials to build the project. f. Construct the project.

Student Competency Profile

Student's Name: _____

This record is intended to serve as a method of noting student achievement of the competencies in each unit. It can be duplicated for each student, and it can serve as a cumulative record of competencies achieved in the course.

In the blank before each competency, place the date on which the student mastered the competency.

Unit 1: Leadership and Experiential Learning (SAE)		
	1.	Assess personal career and leadership skills required for employment in the agricultural mechanization industry.
	2.	Participate in local, state, or national FFA activities that provide opportunities for leadership development and career exploration.
	3.	Review individual plans for student SAE programs.
	4.	Maintain agricultural records for an SAE.
Unit 2: Safety Applications in Agricultural Mechanization		
	1.	Conduct agricultural workplace safety inspections to OSHA standards.
	2.	Demonstrate safety procedures associated with equipment and tools in the agricultural mechanization workplace.
Unit 3: Hydraulic and Pneumatic Systems in Agriculture		
	1.	Explore principles of hydraulics and pneumatics.
Unit 4: Electrical Systems Applications in Agriculture		
	1.	Describe and apply the use of electrical components and systems in agricultural equipment.
	2.	Explore the functions of basic electric and electronic devices (e.g., conductors, switches, diodes, rheostats, resistors, semiconductors, and potentiometers.)
	3.	Demonstrate how an electrical system is used in various types of agricultural equipment:
	4.	Calculate and measure electrical power:
	5.	Apply electrical wiring and trouble-shooting skills to successfully wire an operational agricultural project.
Unit 5: Management and Operation of Agricultural Equipment		
	1.	Describe the importance of machinery management and maintenance.
	2.	Demonstrate the proper safety practices and operational skills for mechanized agricultural equipment.
	3.	Demonstrate recommended maintenance practices for agricultural equipment.
	4.	Develop diagnostic skills and demonstrate approved repair procedures for agricultural equipment.

Unit 6: Principles of Internal Combustion Gas Engines		
	1.	Describe the functions and operation of major systems of a small gasoline engine.
	2.	Disassemble, inspect, and reassemble a small gasoline engine.
Unit 7: Principles of Internal Combustion Diesel Engines		
	1.	Investigate the functions and operation of major systems of a diesel engine.
	2.	Disassemble, inspect, and reassemble a diesel engine.
Unit 8: Application of Metal Fabrication in Agriculture		
	1.	Review welding techniques and perform welding techniques using shielded metal arc welding (SMAW- "stick").
	2.	Review and perform welding techniques using gas metal arc welding
	3.	Perform welding brazing techniques.
	4.	Observe methods of metal fabrication using a programmable plasma cutter/computer numerical control (CNC) machine.
	5.	Apply skills learned in metal fabrication on a welding fabrication project.
Unit 9: Application of Agricultural Technology Mechanical Systems		
	1.	Apply skills learned to repair an agricultural mechanics project for a specified purpose.
	2.	Design and/or build an agricultural mechanics project.

Appendix A: Industry Standards

AGRICULTURE, FOOD AND NATURAL RESOURCES (AFNR) PATHWAY CONTENT STANDARDS AND PERFORMANCE ELEMENTS

	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9
AFNR									
ABS AGRIBUSINESS SYSTEMS	X								
CRP CAREER READY PRACTICES	X	X	X	X	X	X	X	X	X
CS AGRICULTURE, FOOD AND NATURAL RESOURCES CLUSTER SKILL	X	X	X	X	X	X	X	X	X
PST POWER, STRUCTURAL, AND TECHNICAL SYSTEMS	X	X	X	X	X	X	X	X	X

ABS AGRIBUSINESS SYSTEMS
AS ANIMAL SYSTEMS
BS BIOTECHNOLOGY
CRP CAREER READY PRACTICES
CS AGRICULTURE FOOD AND NATURAL RESOURCES CLUSTER SKILL
ES ENVIRONMENTAL SERVICE SYSTEMS
FPP FOOD PRODUCTS AND PROCESSING SYSTEMS
NRS NATURAL RESOURCE SYSTEMS
PS PLANT SYSTEMS
PST POWER, STRUCTURAL, AND TECHNICAL SYSTEMS

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Agribusiness Systems Career Pathway Content Standards

The Agribusiness Systems (ABS) Career Pathway encompasses the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), and business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application and management of agribusiness systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agribusiness Systems (AG-ABS) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

ABS.01. CCTC Standard: Apply management planning principles in AFNR businesses.

ABS.01.01. Performance Indicator: Apply micro- and macroeconomic principles to plan and manage inputs and outputs in an AFNR business.

ABS.01.02. Performance Indicator: Read, interpret, evaluate and write statements of purpose to guide business goals, objectives and resource allocation.

ABS.01.03. Performance Indicator: Devise and apply management skills to organize and run an AFNR business in an efficient, legal and ethical manner.

ABS.01.04. Performance Indicator: Evaluate, develop and implement procedures used to recruit, train and retain productive human resources for AFNR businesses.

ABS.02. CCTC Standard: Use record keeping to accomplish AFNR business objectives, manage budgets and comply with laws and regulations.

ABS.02.01. Performance Indicator: Apply fundamental accounting principles, systems, tools and applicable laws and regulations to record, track and audit AFNR business transactions (e.g., accounts, debits, credits, assets, liabilities, equity, etc.).

ABS.02.02. Performance Indicator: Assemble, interpret and analyze financial information and reports to monitor AFNR business performance and support decision-making (e.g., income statements, balance sheets, cash-flow analysis, inventory reports, break-even analysis, return on investment, taxes, etc.).

ABS.03. CCTC Standard: Manage cash budgets, credit budgets and credit for an AFNR business using generally accepted accounting principles.

ABS.03.01. Performance Indicator: Develop, assess and manage cash budgets to achieve AFNR business goals.

ABS.03.02. Performance Indicator: Analyze credit needs and manage credit budgets to achieve AFNR business goals.

ABS.04. CCTC Standard: Develop a business plan for an AFNR business.

ABS.04.01. Performance Indicator: Analyze characteristics and planning requirements associated with developing business plans for different types of AFNR businesses.

ABS.04.02. Performance Indicator: Develop production and operational plans for an AFNR business.

ABS.04.03. Performance Indicator: Identify and apply strategies to manage or mitigate risk.

ABS.05. CCTC Standard: Use sales and marketing principles to accomplish AFNR business objectives.

ABS.05.01. Performance Indicator: Analyze the role of markets, trade, competition and price in relation to an AFNR business sales and marketing plans.

ABS.05.02. Performance Indicator: Assess and apply sales principles and skills to accomplish AFNR business objectives.

ABS.05.03. Performance Indicator: Assess marketing principles and develop marketing plans to accomplish AFNR business objectives.

Common Career Technical Core Career Ready Practices Content Standards

The CCTC CRPs encompass fundamental skills and practices that all students should acquire to be career ready such as: responsibility, productivity, healthy choices, maintaining personal finances, communication, decision-making, creativity and innovation, critical thinking, problem solving, integrity, ethical leadership, management, career planning, technology use and cultural/global competency. Students completing a program of study in any AFNR career pathway will demonstrate the knowledge, skills and behaviors that are important to career ready through experiences in a variety of settings (e.g., classroom, CTSO, work-based learning, community etc.).

DEFINITIONS: Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for CRPs from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a CTE program of study.

CRP.01. CCTC Standard: Act as a responsible and contributing citizen and employee.

CRP.01.01. Performance Indicator: Model personal responsibility in the workplace and community.

CRP.01.02 Performance Indicator: Evaluate and consider the near-term and long-term impacts of personal and professional decisions on employers and community before taking action.

CRP.01.03. Performance Indicator: Identify and act upon opportunities for professional and civic service at work and in the community.

CRP.02. CCTC Standard: Apply appropriate academic and technical skills.

CRP.02.01. Performance Indicator: Use strategic thinking to connect and apply academic learning, knowledge and skills to solve problems in the workplace and community.

CRP.02.02. Performance Indicator: Use strategic thinking to connect and apply technical concepts to solve problems in the workplace and community.

CRP.03. CCTC Standard: Attend to personal health and financial well-being.

CRP.03.01. Performance Indicator: Design and implement a personal wellness plan.

CRP.03.02. Performance Indicator: Design and implement a personal financial management plan.

CRP.04. CCTC Standard: Communicate clearly, effectively and with reason.

CRP.04.01. Performance Indicator: Speak using strategies that ensure clarity, logic, purpose and professionalism in formal and informal settings.

CRP.04.02. Performance Indicator: Produce clear, reasoned and coherent written and visual communication in formal and informal settings.

CRP.04.03. Performance Indicator: Model active listening strategies when interacting with others in formal and informal settings.

CRP.05. CCTC Standard: Consider the environmental, social and economic impacts of decisions.

CRP.05.01. Performance Indicator: Assess, identify and synthesize the information and resources needed to make decisions that positively impact the workplace and community.

CRP.05.02. Performance Indicator: Make, defend and evaluate decisions at work and in the community using information about the potential environmental, social and economic impacts.

CRP.06. CCTC Standard: Demonstrate creativity and innovation.

CRP.06.01. Performance Indicator: Synthesize information, knowledge and experience to generate original ideas and challenge assumptions in the workplace and community.

CRP.06.02. Performance Indicator: Assess a variety of workplace and community situations to identify ways to add value and improve the efficiency of processes and procedures.

CRP.06.03. Performance Indicator: Create and execute a plan of action to act upon new ideas and introduce innovations to workplace and community organizations.

CRP.07. CCTC Standard: Employ valid and reliable research strategies.

CRP.07.01. Performance Indicator: Select and implement reliable research processes and methods to generate data for decision-making in the workplace and community.

CRP.07.02. Performance Indicator: Evaluate the validity of sources and data used when considering the adoption of new technologies, practices and ideas in the workplace and community.

CRP.08. CCTC Standard: Utilize critical thinking to make sense of problems and persevere in solving them.

CRP.08.01. Performance Indicator: Apply reason and logic to evaluate workplace and community situations from multiple perspectives.

CRP.08.02. Performance Indicator: Investigate, prioritize and select solutions to solve problems in the workplace and community.

CRP.08.03. Performance Indicator: Establish plans to solve workplace and community problems and execute them with resiliency.

CRP.09. CCTC Standard: Model integrity, ethical leadership and effective management.

CRP.09.01. Performance Indicator: Model characteristics of ethical and effective leaders in the workplace and community (e.g. integrity, self-awareness, self-regulation, etc.).

CRP.09.02. Performance Indicator: Implement personal management skills to function effectively and efficiently in the workplace (e.g., time management, planning, prioritizing, etc.).

CRP.09.03. Performance Indicator: Demonstrate behaviors that contribute to a positive morale and culture in the workplace and community (e.g., positively influencing others, effectively communicating, etc.).

CRP.10. CCTC Standard: Plan education and career path aligned to personal goals.

CRP.10.01. Performance Indicator: Identify career opportunities within a career cluster that match personal interests, talents, goals and preferences.

CRP.10.02. Performance Indicator: Examine career advancement requirements (e.g., education, certification, training, etc.) and create goals for continuous growth in a chosen career.

CRP.10.03. Performance Indicator: Develop relationships with and assimilate input and/or advice from experts (e.g., counselors, mentors, etc.) to plan career and personal goals in a chosen career area.

CRP.10.04. Performance Indicator: Identify, prepare, update and improve the tools and skills necessary to pursue a chosen career path.

CRP.11. CCTC Standard: Use technology to enhance productivity.

CRP.11.01. Performance Indicator: Research, select and use new technologies, tools and applications to maximize productivity in the workplace and community.

CRP.11.02. Performance Indicator: Evaluate personal and organizational risks of technology use and take actions to prevent or minimize risks in the workplace and community.

CRP.12. CCTC Standard: Work productively in teams while using cultural/global competence.

CRP.12.01. Performance Indicator: Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.

CRP.12.02. Performance Indicator: Create and implement strategies to engage team members to work toward team and organizational goals in a variety of workplace and community situations (e.g., meetings, presentations, etc.).

Agriculture, Food, and Natural Resources Cluster Skill Content Standards

The AFNR Cluster Skills (CS) encompasses the study of fundamental knowledge and skills related to all AFNR professions. Students completing a program of study in any AFNR career pathway will demonstrate fundamental knowledge of the nature, scope and relationships of AFNR systems and the skills necessary for analysis of current and historical issues and trends; application of technologies; safety, health and environmental practices; stewardship of natural resources; and exploration of career opportunities.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Agriculture, Food and Natural Resources Career Cluster® (AG) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

CS.01. CCTC Standard: Analyze how issues, trends, technologies and public policies impact systems in the Agriculture, Food & Natural Resources Career Cluster.

- **CS.01.01. Performance Indicator:** Research, examine and discuss issues and trends that impact AFNR systems on local, state, national and global levels.
- **CS.01.02. Performance Indicator:** Examine technologies and analyze their impact on AFNR systems.
- **CS.01.03. Performance Indicator:** Identify public policies and examine their impact on AFNR systems.

CS.02. CCTC Standard: Evaluate the nature and scope of the Agriculture, Food & Natural Resources Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.

- **CS.02.01. Performance Indicator:** Research and use geographic and economic data to solve problems in AFNR systems.
- **CS.02.02. Performance Indicator:** Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

CS.03. CCTC Standard: Examine and summarize the importance of health, safety and environmental management systems in AFNR workplaces.

- **CS.03.01. Performance Indicator:** Identify and explain the implications of required regulations to maintain and improve safety, health and environmental management systems.
- **CS.03.02. Performance Indicator:** Develop and implement a plan to maintain and improve health, safety and environmental compliance and performance.

CS.03.03. Performance Indicator: Apply health and safety practices to AFNR workplaces.

CS.03.04. Performance Indicator: Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.

CS.04. CCTC Standard: Demonstrate stewardship of natural resources in AFNR activities.

CS.04.01. Performance Indicator: Identify and implement practices to steward natural resources in different AFNR systems.

CS.04.02. Performance Indicator: Assess and explain the natural resource related trends, technologies and policies that impact AFNR systems.

CS.05. CCTC Standard: Describe career opportunities and means to achieve those opportunities in each of the Agriculture, Food & Natural Resources career pathways.

CS.05.01. Performance Indicator: Evaluate and implement the steps and requirements to pursue a career opportunity in each of the AFNR career pathways (e.g., goals, degrees, certifications, resumes, cover letter, portfolios, interviews, etc.).

CS.06. CCTC Standard: Analyze the interaction among AFNR systems in the production, processing and management of food, fiber and fuel and the sustainable use of natural resources.

CS.06.01. Performance Indicator: Examine and explain foundational cycles and systems of AFNR.

CS.06.02. Performance Indicator: Analyze and explain the connection and relationships between different AFNR systems on a national and global level.

Power, Structural and Technical Systems Career Pathway Content Standards

The Power, Structural and Technical Systems (PST) Career Pathway encompasses the study of agricultural equipment, power systems, alternative fuel sources and precision technology, as well as woodworking, metalworking, welding and project planning for agricultural structures. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application and management of power, structural and technical systems in AFNR settings.

Within each pathway, the standards are organized as follows:

- ***Common Career Technical Core (CCTC) Standards*** – These are the standards for Power, Structural and Technical Systems (AG-PST) from the 2012 version of the Common Career and Technical Core Standards, which are owned by the National Association of State Directors of Career and Technical Education/National Career Technical Education Foundation and are used here with permission. These statements define what students should know and be able to do after completing instruction in a program of study for this pathway.
- ***Performance Indicators*** – These statements distill each CCTC Standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related CCTC Standard at the conclusion of a program of study in this area.

PST.01. CCTC Standard: Apply physical science principles and engineering applications to solve problems and improve performance in AFNR power, structural and technical systems.

- **PST.01.01. Performance Indicator:** Apply physical science and engineering principles to assess and select energy sources for AFNR power, structural and technical systems.
- **PST.01.02. Performance Indicator:** Apply physical science and engineering principles to design, implement and improve safe and efficient mechanical systems in AFNR situations.
- **PST.01.03. Performance Indicator:** Apply physical science principles to metal fabrication using a variety of welding and cutting processes (e.g., SMAW, GMAW, GTAW, fuel-oxygen and plasma arc torch, etc.).

PST.02. CCTC Standard: Operate and maintain AFNR mechanical equipment and power systems.

- **PST.02.01. Performance Indicator:** Perform preventative maintenance and scheduled service to maintain equipment, machinery and power units used in AFNR settings.
- **PST.02.02. Performance Indicator:** Operate machinery and equipment while observing all safety precautions in AFNR settings.

PST.03. CCTC Standard: Service and repair AFNR mechanical equipment and power systems.

- **PST.03.01. Performance Indicator:** Troubleshoot, service and repair components of internal combustion engines using manufacturers' guidelines.
- **PST.03.02. Performance Indicator:** Service electrical systems and components of mechanical equipment and power systems using a variety of troubleshooting and/or diagnostic methods.
- **PST.03.03. Performance Indicator:** Utilize manufacturers' guidelines to diagnose and troubleshoot malfunctions in machinery, equipment and power source systems (e.g., hydraulic, pneumatic, transmission, steering, suspension, etc.).

PST.04. CCTC Standard: Plan, build and maintain AFNR structures.

- **PST.04.01. Performance Indicator:** Create sketches and plans for AFNR structures.
- **PST.04.02. Performance Indicator:** Determine structural requirements, specifications and estimate costs for AFNR structures
- **PST.04.03. Performance Indicator:** Follow architectural and mechanical plans to construct, maintain and/or repair AFNR structures (e.g., material selection, site preparation and/or layout, plumbing, concrete/masonry, etc.).

- **PST.04.04. Performance Indicator:** Apply electrical wiring principles in AFNR structures.

PST.05. CCTC Standard: Use control, monitoring, geospatial and other technologies in AFNR power, structural and technical systems.

- **PST.05.01. Performance Indicator:** Apply computer and other technologies (e.g., robotics, CNC, UAS, etc.) to solve problems and increase the efficiency of AFNR systems.
- **PST.05.02. Performance Indicator:** Prepare and/or use electrical drawings to design, install and troubleshoot electronic control systems in AFNR settings.

~~**PST.05.03. Performance Indicator:** Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.~~

Appendix B: 21st Century Skills[1]

21st Century Crosswalk for Science of Agricultural Mechanization Level II											
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	
21st Century Standards											
CS1		X									
CS2		X									
CS3		X									
CS5		X									
CS6		X	X	X	X	X	X	X	X	X	X
CS7		X	X	X	X	X	X	X	X	X	X
CS8		X	X	X	X	X	X	X	X	X	X
CS9		X	X	X	X	X	X	X	X	X	X
CS10			X			X			X		
CS11		X	X	X	X	X	X	X	X	X	X
CS12		X	X	X	X	X	X	X	X	X	X
CS13		X	X	X	X	X	X	X	X	X	X
CS14		X	X	X	X	X	X	X	X	X	X
CS15		X	X	X	X	X	X	X	X	X	X
CS16		X	X	X	X	X	X	X	X	X	X

CSS1 21st Century Themes

CS1 Global Awareness

1. Using 21st century skills to understand and address global issues
2. Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
3. Understanding other nations and cultures, including the use of non-English languages

CS2 Financial, Economic, Business, and Entrepreneurial Literacy

1. Knowing how to make appropriate personal economic choices
2. Understanding the role of the economy in society
3. Using entrepreneurial skills to enhance workplace productivity and career options

CS3 Civic Literacy

1. Participating effectively in civic life through knowing how to stay informed and understanding governmental processes
2. Exercising the rights and obligations of citizenship at local, state, national, and global levels
3. Understanding the local and global implications of civic decisions

CS4 Health Literacy

1. Obtaining, interpreting, and understanding basic health information and services and using such information and services in ways that enhance health
2. Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance, and stress reduction
3. Using available information to make appropriate health-related decisions
4. Establishing and monitoring personal and family health goals

[1] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

5. Understanding national and international public health and safety issues

CS5 Environmental Literacy

1. Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water, and ecosystems.
2. Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).
3. Investigate and analyze environmental issues, and make accurate conclusions about effective solutions.
4. Take individual and collective action toward addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

CSS2 Learning and Innovation Skills

CS6 Creativity and Innovation

1. Think Creatively
2. Work Creatively with Others
3. Implement Innovations

CS7 Critical Thinking and Problem Solving

1. Reason Effectively
2. Use Systems Thinking
3. Make Judgments and Decisions
4. Solve Problems

CS8 Communication and Collaboration

1. Communicate Clearly
2. Collaborate with Others

CSS3 Information, Media and Technology Skills

CS9 Information Literacy

1. Access and Evaluate Information
2. Use and Manage Information

CS10 Media Literacy

1. Analyze Media
2. Create Media Products

CS11 ICT Literacy

1. Apply Technology Effectively

CSS4 Life and Career Skills

CS12 Flexibility and Adaptability

1. Adapt to change
2. Be Flexible

CS13 Initiative and Self-Direction

1. Manage Goals and Time
2. Work Independently
3. Be Self-directed Learners

~~**CS14 Social and Cross-Cultural Skills**~~

~~1. Interact Effectively with others~~

~~2. Work Effectively in Diverse Teams~~

~~**CS15 Productivity and Accountability**~~

~~1. Manage Projects~~

~~2. Produce Results~~

~~**CS16 Leadership and Responsibility**~~

~~1. Guide and Lead Others~~

~~2. Be Responsible to Others~~

Appendix C: College and Career Ready Standards

English Standards

	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	
W.9.1		X									
W.9.2		X									
W.9.3		X									
W.9.4		X									
W.9.5		X									
W.9.6		X									
W.9.7		X									
W.9.8		X									
W.9.9		X									
W.9.10		X									
SL.9.1		X	X	X	X	X	X	X	X	X	X
SL.9.2		X	X	X	X	X	X	X	X	X	X
SL.9.3		X	X	X	X	X	X	X	X	X	X
SL.9.4		X	X	X	X	X	X	X	X	X	X
SL.9.5		X	X	X	X	X	X	X	X	X	X
SL.9.6		X	X	X	X	X	X	X	X	X	X
L.9.1		X									
L.9.2		X									
L.9.3		X									
L.9.4		X									
L.9.5		X									
L.9.6		X									
RST.9-10.1		X	X	X	X	X	X	X	X	X	X
RST.9-10.2		X	X	X	X	X	X	X	X	X	X
RST.9-10.3		X	X	X	X	X	X	X	X	X	X
RST.9-10.4		X	X	X	X	X	X	X	X	X	X
RST.9-10.5		X	X	X	X	X	X	X	X	X	X
RST.9-10.6		X	X	X	X	X	X	X	X	X	X
RST.9-10.7		X	X	X	X	X	X	X	X	X	X
RST.9-10.8		X	X	X	X	X	X	X	X	X	X
RST.9-10.9		X	X	X	X	X	X	X	X	X	X
RST.9-10.10		X	X	X	X	X	X	X	X	X	X
WHST.9-10.1		X									
WHST.9-10.2		X									
WHST.9-10.3		X									
WHST.9-10.4		X									
WHST.9-10.5		X									
WHST.9-10.6		X									
WHST.9-10.7		X									
WHST.9-10.8		X									
WHST.9-10.9		X									
WHST.9-10.10		X									
W.11.1		X									
W.11.2		X									
W.11.3		X									
W.11.4		X									
W.11.5		X									
W.11.6		X									
W.11.7		X									
W.11.8		X									
W.11.9		X									
W.11.10		X									
SL.11.1		X	X	X	X	X	X	X	X	X	X
SL.11.2		X	X	X	X	X	X	X	X	X	X

SL.11-3		X	X	X	X	X	X	X	X	X	X
SL.11-4		X	X	X	X	X	X	X	X	X	X
SL.11-5		X	X	X	X	X	X	X	X	X	X
SL.11-6		X	X	X	X	X	X	X	X	X	X
RST.11-12.1		X									
RST.11-12.2		X									
RST.11-12.3		X									
RST.11-12.4		X									
RST.11-12.5		X									
RST.11-12.6		X									
RST.11-12.7		X									
RST.11-12.8		X									
RST.11-12.9		X									
RST.11-12.10		X									
WHST.11-12.1		X									
WHST.11-12.2		X									
WHST.11-12.6		X									
WHST.11-12.8		X									

College and Career Ready English I

College and Career Ready English I

Writing Text Types and Purposes

W.9.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

W.9.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.

W.9.1b Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.

W.9.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.

W.9.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.9.1e Provide a concluding statement or section that follows from and supports the argument presented.

W.9.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

W.9.2a Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

W.9.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

W.9.2c Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.

College and Career Ready English I

W.9.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic.

W.9.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

W.9.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

W.9.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

W.9.3a Engage and orient the reader by setting out a problem, situation, or observation, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.

W.9.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.
W.9.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole.
W.9.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
W.9.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.9.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)
W.9.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 9–10.)
W.9.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

W.9.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

College and Career Ready English I

W.9.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
W.9.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
W.9.9a Apply grades 9–10 Reading standards to literature (e.g., "Analyze how an author draws on and transforms source material in a specific work [e.g., how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare]").
W.9.9b Apply grades 9–10 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning").

Range of Writing

W.9.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audience.

College and Career Ready English I

SL.9.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
SL.9.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
SL.9.1b Work with peers to set rules for collegial discussions and decision making (e.g., informal consensus, taking votes on key issues, and presentation of alternate views), clear goals and deadlines, and individual roles as needed.
SL.9.1c Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

SL.9.1d Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
SL.9.2 Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
SL.9.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any fallacious reasoning or exaggerated or distorted evidence.

Presentation of Knowledge and Ideas

SL.9.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

College and Career Ready English I

SL.9.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
SL.9.6 Adapt speech to a variety of contexts and tasks, demonstrating command of formal English when indicated or appropriate. (See grades 9–10 Language standards 1 and 3 for specific expectations.)

College and Career Ready English I
Language
Conventions of Standard English

L.9.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
L.9.1a Use parallel structure.*
L.9.1b Use various types of phrases (noun, verb, adjectival, adverbial, participial, prepositional, absolute) and clauses (independent, dependent; noun, relative, adverbial) to convey specific meanings and add variety and interest to writing or presentations.
L.9.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
L.9.2a Use a semicolon (and perhaps a conjunctive adverb) to link two or more closely related independent clauses.
L.9.2b Use a colon to introduce a list or quotation.
L.9.2c Spell correctly

Knowledge of Language

L.9.3 Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening
L.9.3a Write and edit work so that it conforms to the guidelines in a style manual (e.g., MLA Handbook, Turabian's Manual for Writers) appropriate for the discipline and writing type.

Vocabulary Acquisition and Use

L.9.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.
L.9.4a Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L.9.4b Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy).

College and Career Ready English I

L.9.4c Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.
L.9.4d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).

L.9.5 Demonstrate understanding of figurative language, word relationships, and nuances in word meanings.
L.9.5a Interpret figures of speech (e.g., euphemism, oxymoron) in context and analyze their role in the text.
L.9.5b Analyze nuances in the meaning of words with similar denotations.
L.9.6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

College and Career Ready English II

Grades 9-10: Literacy in Science and Technical Subjects
Reading in Science and Technical Subjects Key Ideas and Details
RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
RST.9-10.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Craft and Structure
RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
RST.9-10.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
RST.9-10.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas
RST.9-10.7 Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
RST.9-10.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts

Range of Reading and Level of Text Complexity
RST.9-10.10 By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

Grades 9-10: Writing in History/SS, Science, and Technical Subjects
Writing Text Types and Purposes
WHST.9-10.1 Write arguments focused on discipline-specific content.
WHST.9-10.1a Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
WHST.9-10.1b Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
WHST.9-10.1c Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
WHST.9-10.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

WHST.9-10.1e Provide a concluding statement or section that follows from or supports the argument presented.
WHST.9-10.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.9-10.2a Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
WHST.9-10.2b Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.

Grades 9-10
Writing in History/SS, Science, and Technical Subjects

WHST.9-10.2c Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
WHST.9-10.2d Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
WHST.9-10.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
WHST.9-10.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
WHST.9-10.3 Not Applicable

Production and Distribution of Writing

WHST.9-10.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
WHST.9-10.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

WHST.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

WHST.9-10.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.

Grades 9-10
Writing in History/SS, Science, and Technical Subjects
Range of Writing

WHST.9-10.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

English III

English III
Writing

W.11.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
W.11.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences claim(s), counterclaims, reasons, and evidence.
W.11.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.
W.11.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
W.11.1d Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
W.11.1e Provide a concluding statement or section that follows from and supports the argument presented.
W.11.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.
W.11.2a Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

English III

W.11.2b Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
W.11.2c Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
W.11.2d Use precise language, domain-specific vocabulary, and techniques such as metaphor, simile, and analogy to manage the complexity of the topic.
W.11.2e Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
W.11.2f Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).
W.11.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
W.11.3a Engage and orient the reader by setting out a problem, situation, or observation and its significance, establishing one or multiple point(s) of view, and introducing a narrator and/or characters; create a smooth progression of experiences or events.
W.11.3b Use narrative techniques, such as dialogue, pacing, description, reflection, and multiple plot lines, to develop experiences, events, and/or characters.
W.11.3c Use a variety of techniques to sequence events so that they build on one another to create a coherent whole and build toward a particular tone and outcome (e.g., a sense of mystery, suspense, growth, or resolution).
W.11.3d Use precise words and phrases, telling details, and sensory language to convey a vivid picture of the experiences, events, setting, and/or characters.
W.11.3e Provide a conclusion that follows from and reflects on what is experienced, observed, or resolved over the course of the narrative.

Production and Distribution of Writing

W.11.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3 above.)

English III

W.11.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (Editing for conventions should demonstrate command of Language standards 1–3 up to and including grades 11–12.)
W.11.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

W.11.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
W.11.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
W.11.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
W.11.9a Apply grades 11–12 Reading standards to literature (e.g., "Demonstrate knowledge of eighteenth-, nineteenth- and early-twentieth-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics").
W.11.9b Apply grades 11–12 Reading standards to literary nonfiction (e.g., "Delineate and evaluate the reasoning in seminal U.S. texts, including the application of constitutional principles and use of legal reasoning [e.g., in U.S. Supreme Court Case majority opinions and dissents] and the premises, purposes, and arguments in works of public advocacy [e.g., The Federalist, presidential addresses]").

Range of Writing

W.11.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

English III
Speaking and Listening
Comprehension and Collaboration

SL.11.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
SL11.1a Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
SL.11.1b Work with peers to promote civil, democratic discussions and decision making, set clear goals and deadlines, and establish individual roles as needed.
SL.11.1c Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
SL.11.1d Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.
SL.11.2 Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
SL.11.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, assessing the stance, premises, links among ideas, word choice, points of emphasis, and tone used.

Presentation of Knowledge and Ideas

SL.11.4 Present information, findings, and supporting evidence, conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.

English III

SL11.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
SL.11.6 Adapt speech to a variety of contexts and tasks, demonstrating a command of formal English when indicated or appropriate. (See grades 11–12 Language standards 1 and 3 for specific expectations.)

English III

Grades 11-12: Literacy in Science and Technical Subjects
Reading in Science and Technical Subjects Key Ideas and Details

RST. 11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

RST.11-12.10 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Grades 11-12: Writing I History/SS, Science and Technical Subjects
Writing
Text Types and Purposes

WHST.11-12.1a Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
WHST.11-12.1b Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
WHST.11-12.1c Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
WHST.11-12.2a Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

~~Grades 11-12: Writing I History/SS, Science and Technical Subjects~~

~~WHST.11-12.2d Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.~~

~~Production and Distribution of Writing~~

~~WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.~~

~~WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.~~

Mathematics Standards											
	Units	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	
N-Q.1		X	X	X	X	X	X	X	X	X	
N-Q.2		X	X	X	X	X	X	X	X	X	
N-Q.3		X	X	X	X	X	X	X	X	X	
8.G.6			X	X	X	X	X	X	X	X	
8.G.7			X	X	X	X	X	X	X	X	
8.G.8			X	X	X	X	X	X	X	X	
G-CO.1			X	X	X	X	X	X	X	X	
G-CO.2			X	X	X	X	X	X	X	X	
G-CO.3			X	X	X	X	X	X	X	X	
G-CO.4			X	X	X	X	X	X	X	X	
G-CO.5			X	X	X	X	X	X	X	X	
G-CO.6			X	X	X	X	X	X	X	X	
G-CO.7			X	X	X	X	X	X	X	X	
G-CO.8			X	X	X	X	X	X	X	X	
G-CO.9			X	X	X	X	X	X	X	X	
G-CO.10			X	X	X	X	X	X	X	X	
G-CO.11			X	X	X	X	X	X	X	X	
G-CO.12			X	X	X	X	X	X	X	X	
G-CO.13			X	X	X	X	X	X	X	X	
G-GPE.5			X	X	X	X	X	X	X	X	
G-GPE.6			X	X	X	X	X	X	X	X	
G-GPE.7			X	X	X	X	X	X	X	X	
G-GMD.1			X	X	X	X	X	X	X	X	
G-GMD.3			X	X	X	X	X	X	X	X	
G-GMD.4			X	X	X	X	X	X	X	X	
G-MG.1			X	X	X	X	X	X	X	X	
G-MG.2			X	X	X	X	X	X	X	X	
G-MG.3			X	X	X	X	X	X	X	X	

Number and Quantity

Reason quantitatively and use unites to solve problems

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.*

N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.*

Geometry

Understand and apply the Pythagorean Theorem

8.G.6 Explain a proof of the Pythagorean Theorem and its converse.

8.G.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Experiment with transformations in the plane

G-CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G-CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs.

Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G-CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G-CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G-CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Understand congruence in terms of rigid motions

G-CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

G-CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G-CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems

G-CO.9 Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.

G-CO.10 Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

G-CO.11 Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.

Geometry Course

Make geometric constructions

G-CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

G-CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Use coordinates to prove simple geometric theorems algebraically

G-GPE.5 Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).

G-GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.

G-GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

Explain volume formulas and use them to solve problems

G-GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.

G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

~~Visualize relationships between two-dimensional and three-dimensional objects~~

~~G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.~~

~~Apply geometric concepts in modeling situations~~

~~G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*~~

~~G-MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*~~

~~G-MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*~~

~~Visualize relationships between two-dimensional and three-dimensional objects~~

~~G-GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.~~

Appendix D: International Society for Technology in Education Standards (ISTE)

	Course	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	
ISTE Standards											
T1		X	X	X	X	X	X	X	X	X	
T2		X	X	X	X	X	X	X	X	X	
T3		X	X	X	X	X	X	X	X	X	
T4		X	X	X	X	X	X	X	X	X	
T5		X	X	X	X	X	X	X	X	X	
T6		X	X	X	X	X	X	X	X	X	

T1 Creativity and Innovation
T2 Communication and Collaboration
T3 Research and Information Fluency
T4 Critical Thinking, Problem Solving, and Decision Making
T5 Digital Citizenship
T6 Technology Operations and Concepts

T1 Creativity and Innovation

Students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology. Students do the following:

a. Apply existing knowledge to generate new ideas, products, or processes.
b. Create original works as a means of personal or group expression.
c. Use models and simulations to explore complex systems and issues.
d. Identify trends and forecast possibilities.

T2 Communication and Collaboration

Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. Students do the following:

a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media.
b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats.
c. Develop cultural understanding and global awareness by engaging with learners of other cultures.
d. Contribute to project teams to produce original works or solve problems.

T3 Research and Information Fluency

Students apply digital tools to gather, evaluate, and use information. Students do the following:

a. Plan strategies to guide inquiry.
b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks.
d. Process data and report results.

T4 Critical Thinking, Problem Solving, and Decision Making

Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students do the following:

a. Identify and define authentic problems and significant questions for investigation.
b. Plan and manage activities to develop a solution or complete a project.
c. Collect and analyze data to identify solutions and/or make informed decisions.
d. Use multiple processes and diverse perspectives to explore alternative solutions.

T5 Digital Citizenship

Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. Students do the following:

a. Advocate and practice safe, legal, and responsible use of information and technology.
b. Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.
c. Demonstrate personal responsibility for lifelong learning.
d. Exhibit leadership for digital citizenship.

T6 Technology Operations and Concepts

Students demonstrate a sound understanding of technology concepts, systems, and operations. Students do the following:

a. Understand and use technology systems.
b. Select and use applications effectively and productively.
c. Troubleshoot systems and applications.
d. Transfer current knowledge to learning of new technologies.